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Railway Mechanical Engineer

FOUNDED IN 1832

as the American Rail-Road Journal with which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

TRANSPORTATION LIBRARY

Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices,
30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

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San Francisco: 58 Main St.

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The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.

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Railway Mechanical Engineer

FOUNDED IN 1832

Vol. 108
1934

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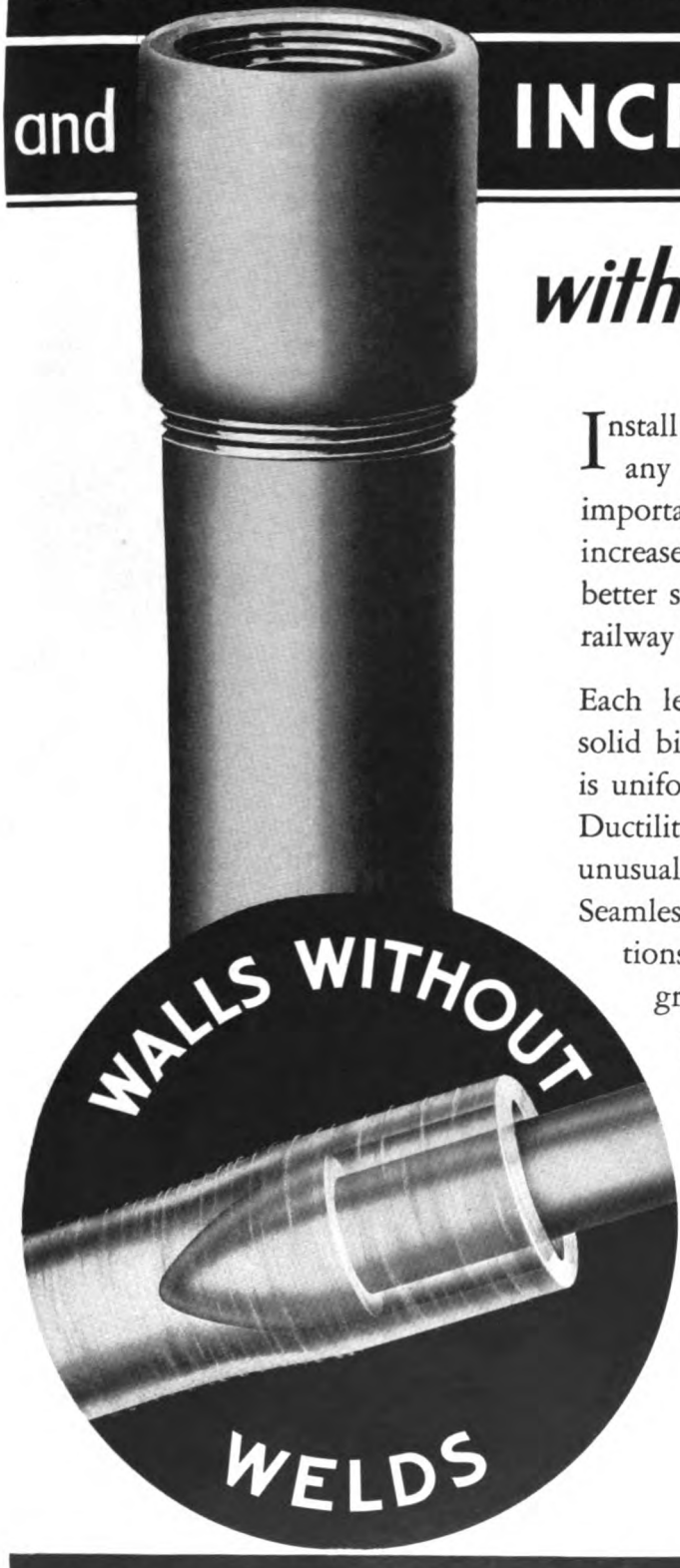
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VOL. 108 No. 1

Published monthly by Simmons-Boardman Publishing Company, 1309 Noble Street, Philadelphia, Pa. Entered as second class matter, April 3, 1933, at the Post Office at Philadelphia, Pa., under the act of March 3, 1879.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

January, 1934

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices,
30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: Terminal Tower
Washington: 17th and H Streets, N. W.
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Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States and possessions: 1 year, $3; 2 years, $5. Canada, including duty: 1 year, $3.50: 2 years, $6. Foreign countries: 1 year, $4; 2 years, $7.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.



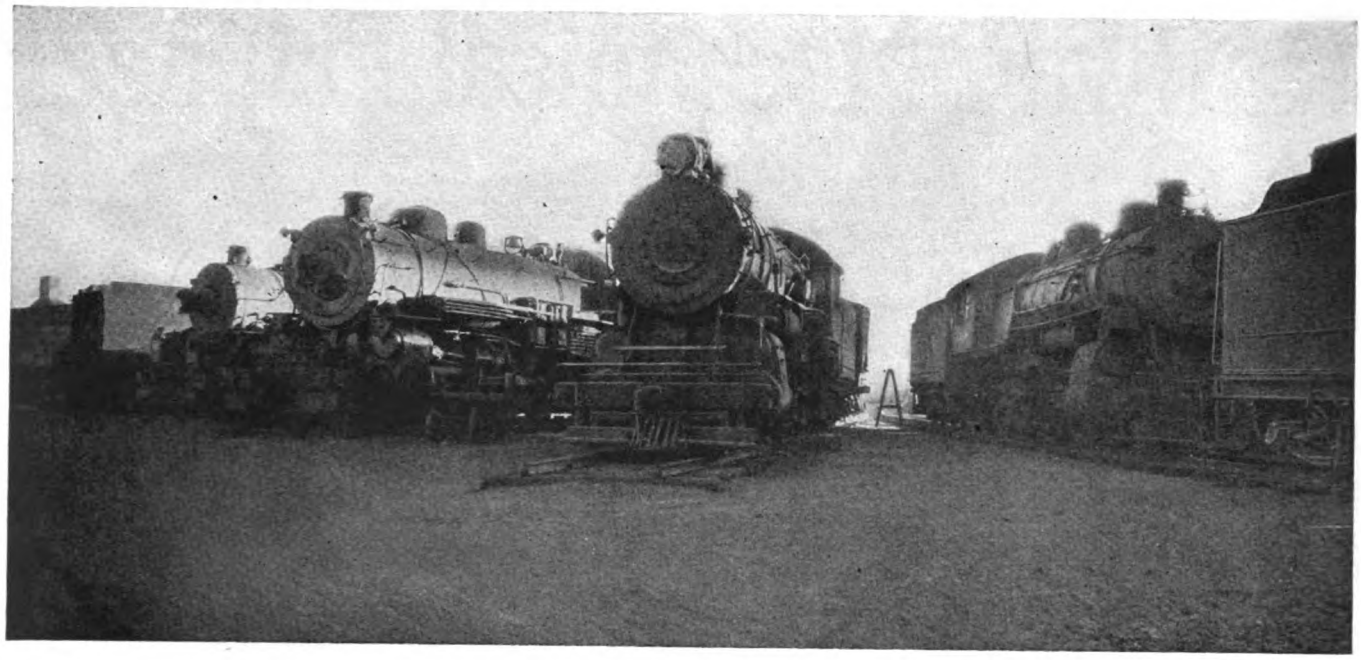
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Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

January - 1934

Service Testing of Journal Lubricants

By Robert Job*

A discussion of the types of oils suitable for car journal lubrication with particular reference to the conditions of operation in extremely low temperatures

THE quality of car oil, as it is termed—or the oil used for lubrication of journals in railroad service—is a prime essential in securing prompt movement of traffic.

In the south with relatively high temperatures, even in winter, a fairly high body or viscosity in the oil is desired in order to maintain a film strength sufficient to meet all ordinary requirements and avoid possibility of seizure between journal and bearing, with the resulting hot box.

In the north or north-west, on the other hand, the summers may be hot, at least during periods, while in the winters a sudden cold snap may drop the temperature to thirty degrees or more below zero, and cars may remain on a siding or in a yard for hours at a time or overnight, fully exposed to the weather.

Formerly, and sometimes today, two grades of oil were used—for summer an oil of good viscosity, say 55 to 60 sec. S. U. at 210 deg. F., and for winter use an oil with moderate viscosity, say 50 sec. at 210 deg. F. or even considerably less, combined with the ability to remain fluid at low temperatures.

Unfortunately for the peace of mind of mechanical and operating officers, oil which is placed in journal boxes during the summer months is apt in a good many cases to remain in the boxes when cold weather comes with resulting waste-grabs and hot boxes, unless the boxes are repacked with winter oil or unless addition of distillate, cut-back oil or other light-bodied, low-cold-test oil is made to the boxes before advent of cold weather. Such treatment requires special care and attention and is inconvenient, and hence the demand has grown for a year-round oil suitable for summer use and even during extremes of winter. From the nature of the case such demands are exacting, but they have been met with a fair degree of success, though certain properties must be present, or absent, or hot boxes certainly will develop when the temperatures are low.

Successful lubrication with the much desired freedom from trouble necessitates a careful balancing of the many conditions of service, and practical experience under these same conditions undoubtedly is the surest guide in determining just what physical properties in the lubricant are most likely to fulfill the requirements, and it should be kept in mind that an oil suitable for year-round service in some sections of the country, may be entirely unsuited for service under more rigorous climatic conditions.

Table I shows the properties of various car oils which have been thoroughly tried in service under low temperature conditions.

Table I

	1	2	3	4
Service	Unsatisfactory	Unsatisfactory	Generally satisfactory	Under trial
Gravity, 60 deg. F., A. P. I.	19.3 deg.	25.1 deg.	26.7 deg.	22.1 deg.
Flash	325 deg. F.	340 deg. F.	380 deg. F.	35[illegible] deg. F.
Viscosity, S. U.:				
@100 deg. F.	475 sec.	300 sec.	295 sec.	305 sec.
@210 deg. F.	56 sec.	54 sec.	49 sec.	50 sec.
-30 deg. F., A. S. T. M. Chart	2,000,000	190,000	625,000	600,000
Precipitation number	Trace	Trace	None	None
Pour point, A. S. T. M.	0 deg. F.	0 deg. F. to + 10 deg. F.	-30 deg. F.	-30 deg. F.
Cold test, Dudley	0 deg. F.	+30 deg. F.	-30 deg. F.	-30 deg. F.
Base	Naphthene	Paraffin	Mixed base	Naphthene
Carbon residue	1.54	2.43	0.82	1.30

In service, Oil No. 1, a naphthene base with relatively high viscosity, proved very unsatisfactory during periods of extreme cold—30 deg. or more below zero F.

Oil No. 2, a paraffin base, with good viscosity for use under normal conditions, also proved unsatisfactory

* Vice-president, Milton Hersey Company, Ltd., Montreal, and chief chemist, Canadian National Railways.

at very low temperatures. In the case of this oil it should be noted that the cold test or pour point is very erratic under the two methods of test, for reasons which will be stated below.

Oil No. 3 gave good average service as a year-round oil.

Oil No. 4 has given good average service during the past spring and summer months. It has not as yet been tested by us in service during the winter, though we anticipate generally favorable results due to its fluidity at relatively low temperatures, even after freezing and thawing and without subsequent preheating, combined with absence of tarry matter.

On referring now to the viscosities of these oils, it will be seen that there is a wide difference between those of No. 1 in comparison with the others, and the projected viscosity of No. 1 at minus 30 deg. F. upon the A. S. T. M. Chart is extremely high. Oils Nos. 2, 3 and 4 have about the same viscosity at 100 deg. F. and not widely different properties at 210 deg. F. When, however, we turn to the pour points, the differences are of striking significance, and in order to point our meaning, a few words of explanation will be necessary.

The Importance of "Pour Point"

When car oil is shipped from a refinery during the winter in a northern climate it may, before reaching destination, be subjected to a very low temperature—say 30 deg. below zero—so that when received it may be frozen solid or nearly so. The oil may be allowed to remain in the shop or stores without special heating until fluid, if not so when received, subsequently being placed in service subject to the ups and downs of winter weather and alternately frozen or thawed.

An important reason for determining the pour point or cold test of a car oil is, as once tersely stated, "to enable one to select an oil that can be applied to a journal from an oil can," and, we might add, at the outdoor temperature prevailing at that time. This leads to a consideration of the methods for determining the "pour point" of an oil.

The standard method of the American Society for Testing Materials specifies that the sample, when received, shall be heated to 115 deg. F. and then shall be cooled gradually and without agitation until movement of the oil on tilting is just perceptible. Under these conditions the pour point or temperature at which Oil No. 2 remained fluid averaged in different shipments about zero degrees F., yet when this same oil was first frozen, as in service, and then *without heating to 115 deg. F.* was gradually cooled, it became solid at about thirty degrees above zero. We thus have the anomalous condition that an oil with an indicated pour point of zero degrees F. actually under the conditions of service may be solid—frozen stiff—at a temperature thirty degrees or so higher. This statement means, of course, that the A. S. T. M. method with its preliminary preheating may give unreliable and misleading indications as to what actually may happen in low temperature service and of the temperature at which the oil may be applied to the journal from an oil can. As a result of this investigation we abandoned the A. S. T. M. pour point in estimating the suitability of oils for use at low temperatures and reverted to the old cold test method devised by Dr. Dudley on the Pennsylvania many years ago. By this well-known method two ounces of the oil are placed in a four-ounce oil bottle, a thermometer inserted, and the oil frozen. Dry Ice is convenient for low-temperature car oils. When the oil is frozen hard the bottle is taken from the freezing mixture and the frozen oil carefully stirred with the thermometer until the oil will flow. This is considered the cold test.

We have used this method for many years in low-temperature work and have always found that the results tallied with those obtained under practical service operating conditions. In other words, the method indicates correctly at what temperature the oil in the oil can or in the journal box will flow or pour after being exposed to low temperatures and without subsequent warming to 115 deg. F. In the cases of the four oils which we have described the indications given by this method corresponded with what actually occurred in service when the oil had been chilled or frozen in transit.

Referring again to Table I it will be seen that in Oil No. 3 (mixed base) and Oil No. 4 (naphthene base) the results by both cold test methods are in agreement, whereas in the case of Oil No. 2 with paraffin base the wide difference to which we have referred appears, due to the separation of paraffin wax. It is hardly necessary to state that any method of test to be of definite practical value must give advance information as to the ability of the material successfully to meet the conditions of service.

Research Has Answered Many Questions

During recent years, investigation work of great importance and interest has been in progress in connection with the technology of lubricants. The relation of viscosities at different temperatures has been carefully studied and as an outgrowth of this work we have the viscosity charts of C. M. Larson of Sinclair Refining Company and of the A. S. T. M. by means of which the behavior of oils which remain fluid at low temperatures may be predicted with a fair degree of certainty. Also the viscosity index, involving a tremendous volume of detail tests and study, permits classification of lubricants along lines which only a few years ago were far less generally understood or appreciated.

In the field of practical low temperature research the work of Chapman on the Santa Fe is worthy of particular note as it gives definite answers to many questions which from their very nature previously had been matters of conjecture, or of painful experience. These researches combined have given a most useful fund of information, though much remains to be learned. In low temperature work we know of the supposedly "slippery" properties of paraffin base oils and of the "sticky" nature of the asphaltic base, but after all, these terms may be merely relative and descriptive of conditions resulting from the presence of small proportions of various constituents or impurities, and capable of correction by means of suitable changes in the methods of refining. What occurs at one temperature may be quite different from that found at a lower range, and as instances in point we may cite Oil No. 1, in our table, the asphaltic type, which in service was unsatisfactory under our northern winter conditions due to "waste grabbing." Also Oil No. 2, the paraffin type, which in theory should have been satisfactory even though solid, but which in practice under low temperatures was not a success, also causing difficulty due to "waste-grabs," and cutting off lubrication just at the time when it was most urgently needed. Oil No. 3, mixed base, might have been expected to become more "sticky" at low temperatures, but in practice it gave far better service under such conditions than Oils No. 1 and No. 2, and similar service is anticipated for Oil No. 4, due considerably, we think, to the fact that in addition to being free from tarry matter, also even at fairly low temperatures (thirty degress below zero) it remained in a fluid condition and thus was capable of feeding the journals, avoiding possibility of waste-grabs. This state of fluidity under the conditions of service

combined with absence of tarry matter we consider in the light of our experience most important factors in the securing of efficient lubrication at low temperature ranges.

In the present paper we have stated the facts as we have found them with the thought that they might serve to help in the general study of the varied requirements of service of this important lubricant and also promote thought and discussion as to the simplest and most effective methods for modifying the properties of the lubricant so that it may meet successfully the conditions which exist in service. Experience in the past has shown that when once the real cause of a difficulty clearly has been known, a suitable remedy generally has not been far distant, and we feel that developments in refining—possibly ones which are very simple—may be found effective in eliminating or modifying the properties of constituents which in low temperature service produce an undesirably strong bond between journal and waste.

The investigation outlined above was undertaken with the active cooperation of the late C. E. Brooks, chief of motive power and rolling equipment, Canadian National Railways, and of his successor, John Roberts.

The Mechanical Department And Purchase of Materials

A purchasing officer suggests ways in which the department can co-operate to better advantage

"WHAT," I asked the Purchasing Officer, "can a mechanical department officer do, from your point of view, which will help improve the efficiency of railway operation as a whole?"

I interviewed this particular purchasing officer because I felt that on the basis of his earlier training and experiences he would approach the subject with a sympathetic understanding and on a more or less fact or scientific basis. He had not the slightest intimation in advance of why I wished to see him and his reactions where therefore more or less automatic—he had no time for making a studied reply.

Unripe Plans

"First," said he, "as I think of it now, one of our difficulties in handling material for the mechanical department has been due to 'unripe plans.' A project is started, considerable amounts of material are ordered and placed in stock, and then without a moment's notice, the plans are changed. In some instances, of course, the material can be adapted for other purposes without too great a loss, but sometimes it is of such special design or nature that we cannot make use of it. Eventually, of course, it is sold as scrap or destroyed; meantime it takes up valuable space and is a constant source of expense. More study and consideration in the first place would have avoided or have considerably reduced this hazard."

"What point would you make next?" I queried.

Reasonable Assurance of Success

"You understand," replied the Purchasing Officer, "that I am not making these suggestions in the order of their importance, but simply as they come to mind. The second thought that occurs to me—and it is closely allied to the point that I have already made—is that in a few instances, at least, the mechanical department on our road has made rather large installations of devices or equipment without having reasonable assurance of a successful outcome.

"I do not mean to infer that the railroads should not experiment with different designs and different types of equipment; as a matter of fact, that is the only way in which progress can be made. We must expect a certain percentage of failures as we experiment with new ideas. I have noticed, however, that in the enthusiasm of the moment, department officers will sometimes place rather large orders for a new or experimental device which has not yet been tried out thoroughly on our own road, or any other railroad, for that matter. We stock up with spare parts for repairs, or extra sets for application as the equipment is rebuilt. The bubble bursts and we find ourselves with surplus unusable stock on hand. An examination of our storehouses or storeyards will unearth several white elephants of this sort." The Purchasing Agent mentioned some of these "white elephants" by name. I hesitate to identify them because of sad memories that they may stir up in some quarters.

Before I could ask another question the Purchasing Officer started to make another observation.

Research within the Department

"It seems to me that the mechanical department should do a greater amount of research, within its own organization, as to the suitability and performance of different materials and different products. The railway supply people have made a remarkable job in improving their devices and materials, but frequently when a number of different companies make bids on a tool or a material, we have great difficulty in determining the relative value of the different makes. I am thinking now of common products used in everyday service; it would seem that the mechanical department would, to protect its own interests, make careful tests and comparisons, in order to be sure that it is furnished with the best product for the particular purpose for which it is required.

"I can see by the expression on your face that you are surprised at this statement. And yet, if you were to spend much time in an average railway purchasing department office, you could easily recognize how valuable it would be to us if such information were readily available. You understand, of course, that we do have a testing department on our road, and that it does test many materials, but on the other hand, there are a great many products which should be given similar treatment and concerning which we have great difficulty in determining which is best suited to the needs of the mechanical department.

"There is still another phase of this problem. There can be no question at all about the importance and value

of many patented articles. Sometimes, however, we find that we pay a very high price per pound for these articles, when a bit of research and investigation might indicate that we could get an equally good product at a lower price. I am not trying to discourage the use of high grade special devices, but rather to insist that more careful research work be done to assure that they are really worth as much as we pay for them, and that some other cheaper product cannot do the job as well, or better."

Programming Work

"How about the purchase of materials for extensive equipment rebuilding programs?" I asked. "Presumably this is a simple proposition, which does not give you much trouble."

"On the contrary," replied the Purchasing Officer, "quite the opposite is true. Too frequently the mechanical department does not give adequate attention to programming the work. For instance, it is quite likely to come at me with a requisition for the material for a large project, asking that all of it be delivered prior to a certain date. A little questioning may develop that the work on the project will extend over many months, or even as much as a year. You can readily understand that the purchasing department may be able to make advantageous contracts for such material on the basis of the time it will actually be needed on the job, allowing, of course, an ample factor of safety to cover emergencies. Handled in this way it also reduces our storekeeping costs and in some instances may prevent finding ourselves with a lot of material on our hands which we cannot use and which in time becomes obsolete.

"Even the best of programs—and this has been particularly true during the last few years—are liable to be canceled or greatly modified if the work extends over a considerable period of time. If the material is delivered, it must be paid for, and if it is not used promptly it piles up our inventories. This programming of work is one of the greatest difficulties that we have to work out with the mechanical department and yet it is of prime importance that such programs be carefully laid out in such a way that the purchasing department can take full advantage of the schedules which may be adopted."

"Presumably," I ventured, "you are kept closely informed as to tendencies in equipment design and can guard against stocking up materials that may become obsolete."

"That is an embarrassing shot," countered the Purchasing Agent. "The mechanical department may study for a long time the possibility of making certain changes in design or of adopting some new specialty. Knowing nothing of what it is doing, we suddenly wake up and find ourselves with a large amount of material on hand, when an order goes out that following such and such a date a new design or device will be applied in place of that which has heretofore been standard equipment. Sometimes, too frequently quite by accident, we learn that the mechanical department is experimenting along certain lines, and then if we are wise we immediately check up on our material and see that new orders are not placed until we are reasonably sure that no changes will be made in the near future.

"Having said all these things by way of suggestion, please do not think that I am critical," continued the Purchasing Agent. "Our relations with the mechanical department are cordial and I am sure that we both do our level best to co-operate with each other. I do believe, however, that much can be done to improve conditions along the lines I have indicated."

The Analysis of Equipment Maintenance*

By Lawrence Richardson †

Accurate records of repair costs and the analysis of these records will serve as a guide to improvements in maintenance conditions

IN analyzing equipment-maintenance expenses for the last 10 years and the corresponding gross income for the same period, the ratios existing between them show the benefits derived by the intensive drive to improve general mechanical efficiency. The relations are shown graphically in Fig. 1. Maintenance-of-equipment expenses have decreased steadily. The ratio of gross income in 1922 was 22.5 while in 1928 it had been reduced to 19.1, a reduction of 15 per cent.

The trend in gross income, comparing 1922 and 1928 has been an increase of 10 per cent. Stated in another way, out of a dollar received in 1922 as gross income, 22.5 cents was spent for equipment repairs, while in 1928 out of the gross income dollar only 19 cents was spent for equipment maintenance. This decreased ratio meant a saving of over $200,000,000 for 1928 as compared with 1922. The ratio has increased slightly during the depression as the use of equipment and the number of units have not dropped as much as has the income.

The gain from the reduced equipment-maintenance expenditures has been entirely net, no additional expense being added to the other departments. In fact, conditions have been markedly improved as reflected by fewer locomotive and car failures. One of the most interesting facts brought out by an analysis of the maintenance-of-equipment expenditures for the 47 largest railroads in the United States is that lowest costs are attended by a better condition of equipment. The fallacy that a good power and car condition costs money is refuted by Figs. 2 and 3.

* The abstract of a paper presented before a meeting of the Railway Club of Pittsburgh held at the Fort Pitt Hotel, Pittsburgh, Pa., September 28, 1933.

† Mechanical assistant to the vice-president and general manager, Boston & Maine.

In the locomotive chart these railroads have been divided into four groups, arranged as to cost of repairs per locomotive mile 0 to 20 cents, 20 to 25 cents, 25 to 30 cents and 30 cents up. The condition of power in each group was taken from federal reports. The average condition in the lowest cost group is the best, while that in the highest cost group is the worst. The leaders in each group show an even more striking relationship. The best condition in the highest cost group is 90 times the best in the lowest cost group.

Fig. 3 showing freight-train-car conditions reflects a similar condition. The costs and condition of cars have been taken from federal reports furnished by the Bureau of Statistics of the I. C. C. The lowest cost group is also the best condition group.

These charts of cost and condition explain the truth of E. H. Harriman's policy that "A dollar saved by deferred maintenance brings about a subsequent expenditure of two dollars."

It is important that savings effected in mechanical maintenance be real economies and not result in a poorer condition that ultimately causes an actual loss.

In checking costs it is important that the effect of age be not overlooked. Fig. 4 shows the relationship existing between age and repair costs. This chart was developed by T. R. Cook.[1] It will be seen that costs

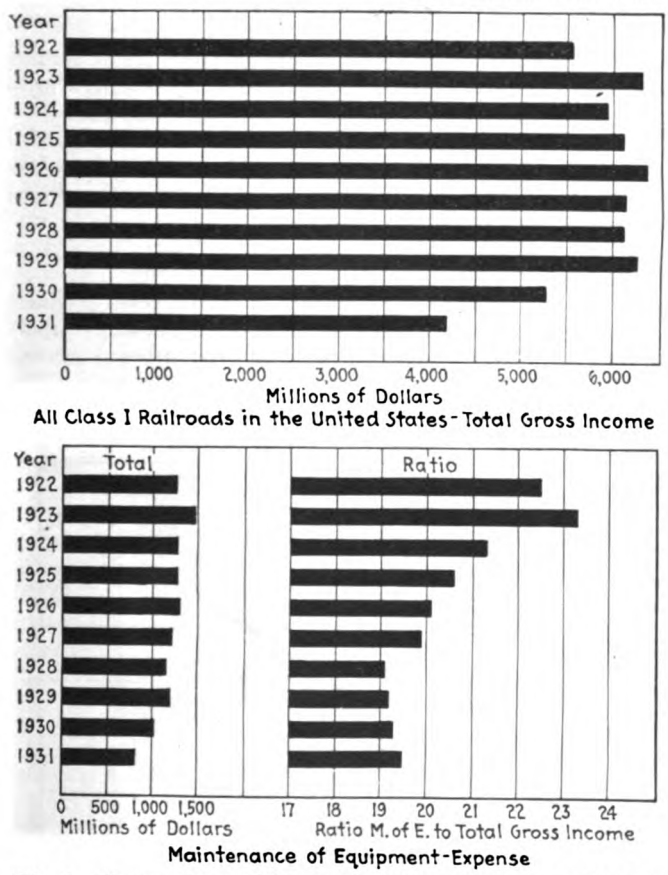


Fig. 1—Comparison of M. of E. expense and gross income for 10-year Period

increase approximately 4 per cent per year. One railroad may have locomotives costing 10 per cent more than another, but if the age of the power exceeds the other by more than 2½ years, its record is actually better.

The transportation department has realized more than a full share of benefit from these conditions. Where a good hot-box record in 1922 was expressed in tens of thousands of miles, in 1932 it was expressed in hundreds of thousands of miles. Locomotive failures have decreased likewise. This has brought train delays due to mechanical failure to a minimum, resulting in faster movements and an almost complete elimination of overtime in through service. Fast freight-train service has approached the reliability of passenger service.

Factors Resulting in Improvement

The three primary factors supporting this improvement in equipment maintenance are (1) higher degree of skill in labor; (2) improved design of equipment, and (3) closer analysis of cost.

The advance in skill is the result of education and stabilization. Supervision plays as large a part in the

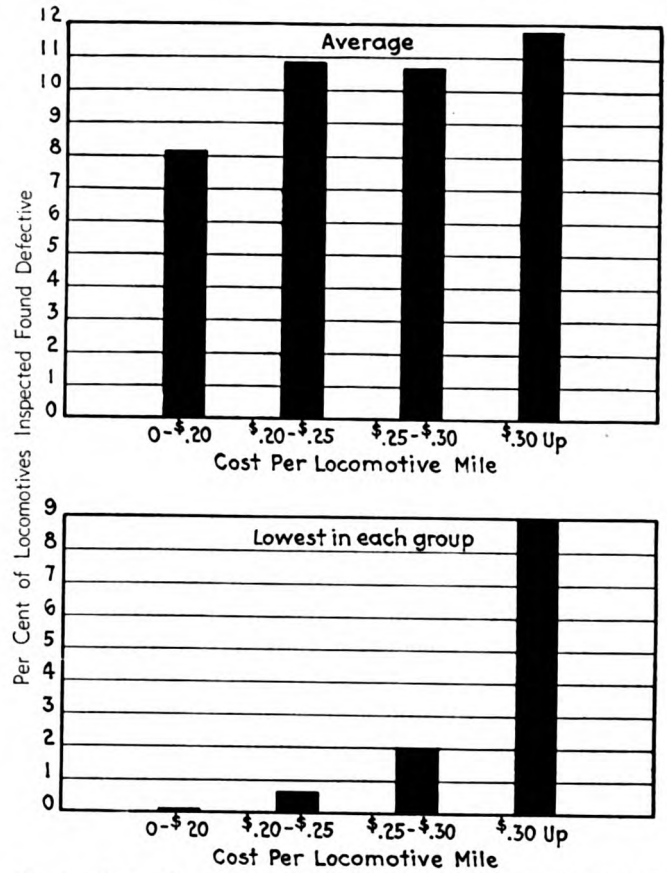


Fig. 2—Cost of repairs per locomotive mile compared with percentage of locomotives inspected and found defective—Data from 47 largest railroads in United States for year 1931

former as does the man. The mechanic arts are constantly advancing. To keep supervisory forces abreast of the times it is necessary to stimulate interest in railroad clubs and associations. Foreman training more than justifies itself in the results attained. An increased number of helpers have been advanced to journeymen. They must be fully schooled in their duties in order to perform properly the work assigned them. Stabilization has eased this problem somewhat as the reduced turnover meant fewer new men hired. Estimates of the cost of hiring a new man and breaking him in average $125, a direct charge which must be absorbed in cost.

Design has played its part in this improvement. A. R. A. committees are constantly at work studying standards and establishing specifications. This work brings about a reduction in the costs of maintenance. The supply concerns have more than contributed their share in the production of better materials and the development of specialties.

[1] Baldwin Locomotive Works.

Research and test work have reduced failures and lengthened service. The draft-gear and air-brake tests conducted by the American Railway Association are two outstanding examples of co-ordinated research with an adequate program and personnel. The benefits to the member roads from these tests and developments have fully justified the efforts.

While general analyses are helpful, it requires an analysis in detail to accomplish the best results. It is not sufficient to know that maintenance in general is high. One must know what parts or members are not giving economical service. But a detailed individual cost accounting of freight cars entails a prohibitive cost, just the same as a test of every bar of steel. To get this desirable information at a reasonable cost, a system was devised to analyze a small number carefully and use this information as a control of the whole series.

Freight Car Costs

Twenty-five cars out of each series were stencilled "M.T.C." To the repairman they are, to all intents and purposes, foreign cars. He makes an A. R. A. bill for

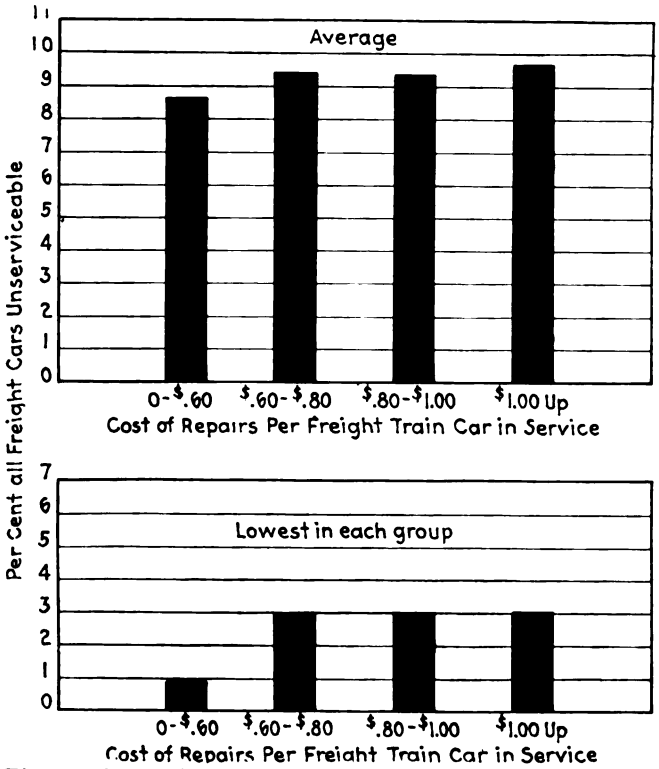


Fig. 3—Cost of repairs per freight-train car in service compared with percentage of all freight cars unserviceable—Data from 47 largest railroads in United States for year 1931

every job. These bills are sorted out as they pass through the A. R. A. Billing Bureau and turned over for compilation and accounting.

Table I shows the costs of running repairs only for a twelve months' period. The general design of the cars is indicated at the top of each column. The figures are self-explanatory. The detail is sufficient to answer questions raised as to performances of individual parts.

Of particular interest are the columns for A. R. A. single-sheathed box cars and all-steel hoppers. The excellence of the design of these cars is quite readily noted. Trips to the repair tracks are few and far between. When a shipper loads one of these cars he has an assurance that his load will go through to destination without being delayed on repair tracks. The principal items of cost are those involving periodical work, principally air-brake cleaning and journal repacking. The new AB brake is solving one problem. Cast steel has already eliminated other causes. The cost of truck parts for these cars to date is nothing. Compare this record with arch-bar and other types of built-up trucks. Such performance assures the safest possible operation.

A study of these costs over a period of years has developed the necessity and economy of doing a complete job when cars are in the shop for general repairs.

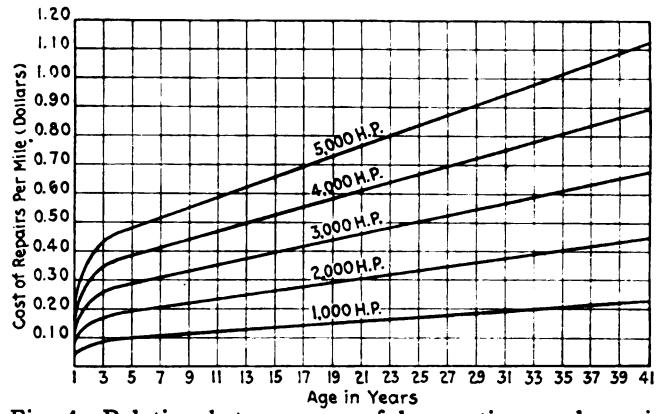


Fig. 4—Relation between age of locomotives and repair cost per mile

Failure to do the required work at such times is not economy in any sense of the word. The bills show that such jobs are only deferred at multiplied costs.

Designers will find these figures are splendid guides for their efforts. They point out the particular items that need attention and betterment. In answering them costs are lowered and service bettered.

Locomotive-Mile Cost Records

Fig. 5 is a locomotive mileage and cost record which is possible to keep up to date with a surprisingly small amount of clerical work. Locomotive miles run are used as a base and cost of classified and running repairs in dollars as ordinates. Radial lines are drawn for

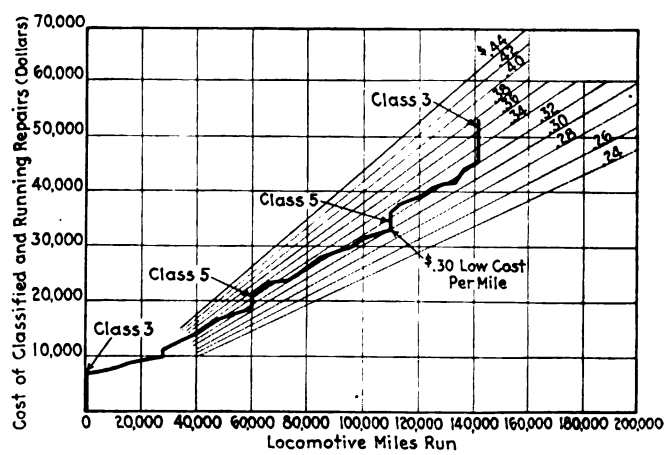


Fig. 5—Locomotive mileage and cost chart

each rate of locomotive repair cost per mile. There is a 26-cent line, a 28-cent line, a 30-cent line, and so on. The lines are readily drawn by the determination of a single point. With that and zero as the other point a straight line is drawn. An average cost of 30 cents per mile at 50,000 miles would be $15,000. At 100,000 miles it would be $30,000. A check of each straight line will show the same relation to hold at any other point.

The cost record of an individual locomotive is shown on the chart. It starts with the cost of a Class 3 repair

Table I—Freight-Car M.T.C. Maintenance Study—One Year Period March 1, 1932, to March 1, 1933, Running Repairs Only—Mechanical Department, Boston & Maine

		60,000-lb. cap. box	80,000-lb. cap. box	U. S. R. A. double-sheathed box	A. R. A. single-sheathed box	Flat	100,000-lb. cap. comp. gondola	140,000-lb. cap. all-steel hopper	Refrig.
1	Wheel changes	$72.60	$37.97	$175.34	$13.40	$215.53	$126.40	$25.55	$182.34
2	Journal boxes	8.99	1.32	12.39	2.27	2.29	15.82	....	17.65
3	Journal bearings	13.02	17.78	12.67	7.84	17.38	26.31	6.44	22.14
4	Brake beams	5.15	.35	22.85	19.40	....	3.55	....	27.18
5	Brake shoes	8.72	12.73	17.59	3.77	5.51	11.40	.56	86.52
6	Truck parts	35.23	182.30	2.41	23.13	6.70	32.49	....	228.94
7	Brake rigging	4.86	10.60	1.90	15.48	7.75	7.30	.40	12.68
8	Train line	7.86	16.92	14.62	1.02	20.34	32.88	1.33	104.49
9	Air hose	9.90	24.75	21.45	28.05	27.42	13.20	23.10	146.85
10	Angle cocks	4.05	2.70	2.70	....	7.05	6.27	1.35	17.55
11	Air-brake cleaning	86.82	86.10	91.31	90.47	77.24	91.07	110.95	27.75
12	Hand brake	....	2.70	3.48	....	21.22	8.65	....	.90
13	S.ll, steps, etc.	16.47	14.87	22.61	1.50	15.04	12.40	1.71	15.89
14	Draft gear	106.85	4.80	1.10	81.09	29.15	.20	2.10	23.21
15	Couplers	46.21	91.32	43.83	5.82	.87	6.37	....	19.29
16	Yokes	11.80	16.60	68.10	....	....	....	....	....
17	Body	27.88	26.31	48.20	54.91	.90	15.17	....	72.36
18	Doors	26.78	70.36	115.01	2.65	....	....	....	46.54
19	Hopper	....	....	....	....	....	18.13	2.87	....
20	Floor	....	....	8.13	2.35	119.26	275.58	....	1.54
21	Lining	13.35	33.90	31.74	9.79	....	....	....	.54
22	Underframe	.55	....	.20	20	....	....	....	.95
23	Center plates	12.46	16.00	5.50	3.73	2.90	....	....	....
24	Miscellaneous	37.80	41.70	75.75	34.25	74.65	57.30	80.60	302.40
25	Total charges	$557.35	$712.08	$798.88	$401.12	$651.20	$760.49	$256.96	$1,357.71
26	No. cars involved	25	24	26	25	25	25	25	25
27	No. car-days—home	8,522	8,121	8,158	7,414	7,964	8,068	8,161	7,263
28	No. car-days—foreign	603	639	1,332	1,711	1,161	1,057	964	37
29	No. car-days—total	9,125	8,760	9,490	9,125	9,125	9,125	9,125	7,310
30	Per cent home days	94	93	86	81	87	88	89	99
31	Per cent foreign days	6	7	14	19	13	12	11	1
32	Maintenance per car-day - home	$.059	$.072	$.085	$.041	$.055	$.084	$.029	$.191
33	Maintenance per car-day - foreign	.088	.198	.081	.055	.175	.081	.020	....
34	Maintenance per car-day—total	$.061	$.081	$.084	$.044	$.071	$.083	$.028	$.191
35	Average age of cars, yrs.	24	21	14	3	10	14	4	26

Note: All of the above cars have steel underframes.

at zero mileage, running costs and mileage being added monthly. It is essentially a curve of total costs vs. total mileage. It is continued until the next general shopping. The curve shown covers an actual case and shows the loss occasioned by running too great a mileage before shopping for general repairs. There were two Class 5 repairs, one at 60,000 miles and the other at 110,000 miles. The cost at 60,000 miles was 31 cents per mile. The Class 5 repair at this point fully justified itself, because the cost dropped to 30 cents at 110,000 miles. However, the Class 5 repair at this point did not justify itself, because the cost only dropped back to 32 cents at 142,000 miles, when it was necessary to shop the locomotive for a Class 3 repair. The actual loss was 2 cents per mile over the entire 142,000 miles, or $2,840.

With charts of each locomotive periodically checked for excess cost per mile, they are particularly useful in determining the economical mileage of each class as well as the proper shopping of each individual locomotive.

Table II shows the information on the reverse side of the card shown in Fig. 5 with a record of the monthly mileage and monthly running and classified repair costs added, the totals only being posted on the chart. A record is also maintained of the classified repairs by points and the total cost of each repair.

The future of mechanical maintenance is challenging. Competition is becoming more pressing, demanding lowered costs. As in the past, the mechanical department is called upon to carry its full share of the load.

Average labor rates in mechanical maintenance are high, being exceeded only by three other groups, according to Department of Labor reports. This means that maximum production and efficiency must be attained to hold our own with lower paid competitive groups. This calls for the best of engineering and planning. It can be done. Mechanical men have successfully met their problems in the past and will continue to meet and solve them as they arise.

A fuller appreciation of mechanical problems by the higher executives will be helpful. Proper backing and an adequate share of capital expenditures will enable mechanical men to do their part. The standard of living in any nation is based on the industrial development of that nation. A high state of mechanical development means a high standard of living. The same is true of individual railroads.

Table II—Locomotive Mileage and Cost Data Card

Locomotive No. 7304. Division ..... Class .....

Month	1929 Repairs	1929 Miles	1930 Repairs	1930 Miles	1931 Repairs	1931 Miles	1932 Repairs	1932 Miles
Jan.	....	....	$ 662	3,764	$ 648	4,864	$ 640	2,584
	....	....	10,226	26,308	26,860	82,976	40,380	125,024
Feb.	....	....	1,976	4,652	964	4,656	802	2,696
	....	....	12,202	30,960	27,824	87,632	41,182	127,720
March	....	....	1,501	4,794	1,076	4,884	598	2,884
	....	....	13,703	35,754	28,900	92,516	41,780	130,604
April	....	....	996	5,780	1,378	5,136	562	2,646
	....	....	14,699	41,534	30,278	97,652	42,342	133,250
May	....	....	966	6,024	1,530	5,064	624	2,040
	....	....	15,665	47,558	31,808	102,716	42,966	135,290
June	....	....	919	4,860	1,156	4,936	688	1,964
	....	....	16,584	52,418	32,964	107,652	43,654	137,254
July	$7,460	3,934	1,204	5,780	3,246	2,100	582	2,460
	7,460	3,934	17,788	58,198	36,210	109,752	44,236	139,714
Aug.	416	3,564	3,256	1,802	664	2,894	574	2,282
	7,876	7,498	21,044	60,000	36,874	112,646	44,810	141,996
Sept.	340	3,736	840	4,540	816	2,640	....	....
	8,216	11,234	21,884	64,540	37,690	115,286	....	....
Oct.	384	3,446	1,370	4,002	594	2,256	....	....
	8,600	14,680	23,254	68,542	38,284	117,542	....	....
Nov.	446	3,364	1,354	4,684	618	2,058	....	....
	9,046	18,044	24,608	73,226	38,902	119,600	....	....
Dec.	518	4,500	1,604	4,886	838	2,840	....	....
	9,564	22,544	26,212	78,112	39,740	122,440	....	....

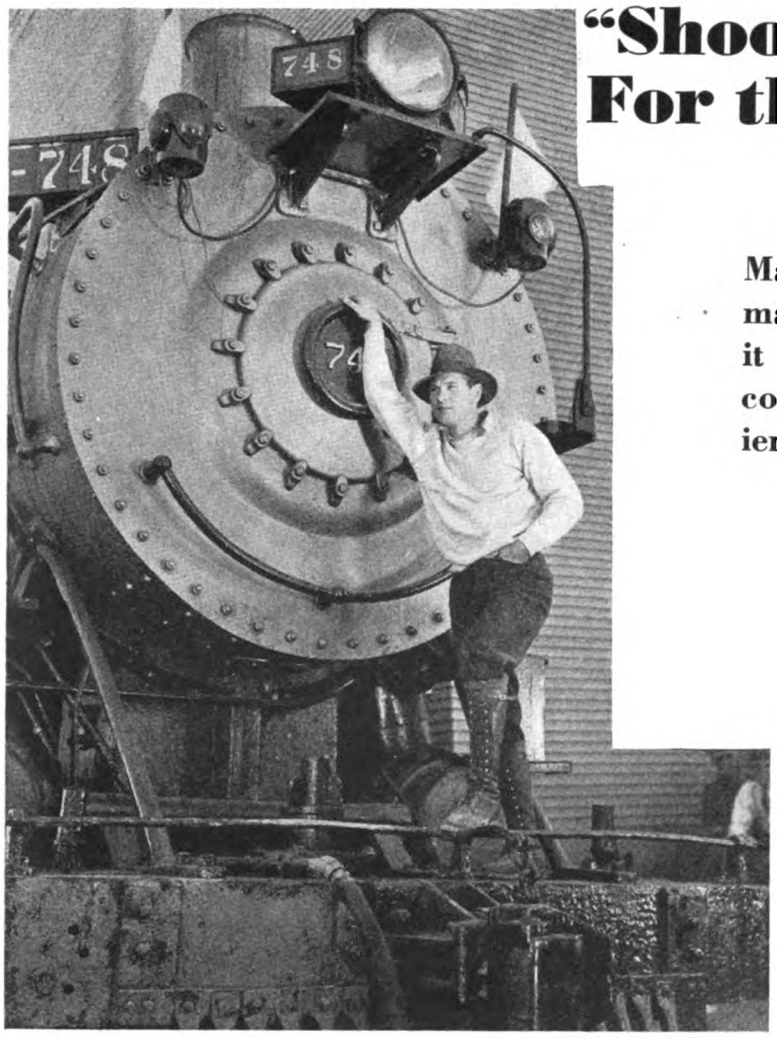
Record of Heavy Repairs

Class	Shop	Cost	Miles
3-6-'29	Bill.	$7,190	....
Un-2-'30	E. Deerfield	1,376	....
5-8-'30	Bill.	2,844	60,000
5-7-'31	Bill.	2,646	110,000
3-9-'32	Bill.	8,458	142,000

"Shooting" Railroads For the Movies

Many train pictures are being made in various studios—How it is done—How the railroads co-operate in bringing the Orient to the camera

By A. B. Laing



Richard Arlen as the strike leader in "Golden Harvest" poses on a locomotive in Oregon

THE first movie actress was a locomotive. You remember—if your theatrical experience embraces Biograph days of 1911—how she roared down the tracks, straight for the folk who sat in the front rows of the opera house. And how those of the audience who believed in Safety First jumped from their seats and scuttled for the aisles and exits; resuming their places only after the danger had passed.

Today this pioneer actress has lost her terror for theatregoers, but none of her early allure. Symbolizing power and speed, drama, passage of time, she is the director's favorite. Performing with ever-increasing realism (thanks to improved cinemacraft and co-operation of railway officials), she has, as Paul Snell, of the Fox organization, puts it, "box-office drawing power."

The thundering express (photographed sometimes from pits excavated under the tracks) spells romance, going places, doing things—excitement for the audience. Trains, moreover, are playing an increasingly important role in screen stories. Whereas the novelist or story teller may *write*, e. g., that his character has left for Chicago via Grand Central, and satisfy his reader, the movie director must *show* her actually leaving; reproduce the sound of whistles and escaping steam and air, and perhaps later show the flyer skimming across the countryside.

Following the financial success of the English-made picture "Rome Express," the Hollywood studios have bought numerous scenarios in which the entire plot or action of the piece is laid aboard some famous flyer. Snell advises that his company is completing one called the "Oriental Express," and directly that big picture is shipped out of the studio in its little tin box, "Sleepers East" will be moving along (in production).

The "Oriental Express" features no star—rather it portrays the love life of a railway conductor with a sweetheart planted in every port of call from Ostend to Jugoslavia. You see the train entering and leaving various continental depots; it is "shot" with such fidelity to detail that you find it difficult to believe it was manufactured *in toto* inside a Hollywood "sound stage."

The Fox company has erected one of these buildings (approximately 500 ft. x 150 ft. x 90 ft.) and equipped it as a permanent "train set." There is a track—standard-gage rails and properly ballasted ties—extending the length of the building and beyond (outdoors). A full size "property" locomotive stands by with a string of four cars which are equipped with regulation air brakes. Exterior working parts of the locomotive are actuated by mechanical means, and the whole train is moved back and forth by an electric winch and wire cables at either end—an ingenious provision for facilitating the endless rehearsals and retakes incidental to first-class motion picture production.

So as not to hamper microphone recording, all escaping steam seen rising around car and cab windows is led in through a 6-in. hose under low pressure and directed to the spot in focus by means of electric fans.

Train orders, dispatches and stationery of all kinds are usually run off in the studio print shop, using fictitious railroad names, so as not to give any one road undue publicity or run foul of the copyright laws.

To adapt it to the "Oriental Express," this entire American train was rebuilt to represent its continental sister. Complete blue prints of the Belgian train were courteously loaned by Les Ateliers Metallurgiques for

the purpose. From these drawings, all coaches were constructed in the Fox shops. Every distinguishing mark of the Belgian train, from heavy forgings to miscellaneous coach hardware, was carefully duplicated. Where possible, junk equipment or spare parts were purchased from local railway shops; otherwise, it was turned out in the studio mechanical departments. All told, about 1,800 studio technicians—from electroplaters to leather workers—obtained employment on the train.

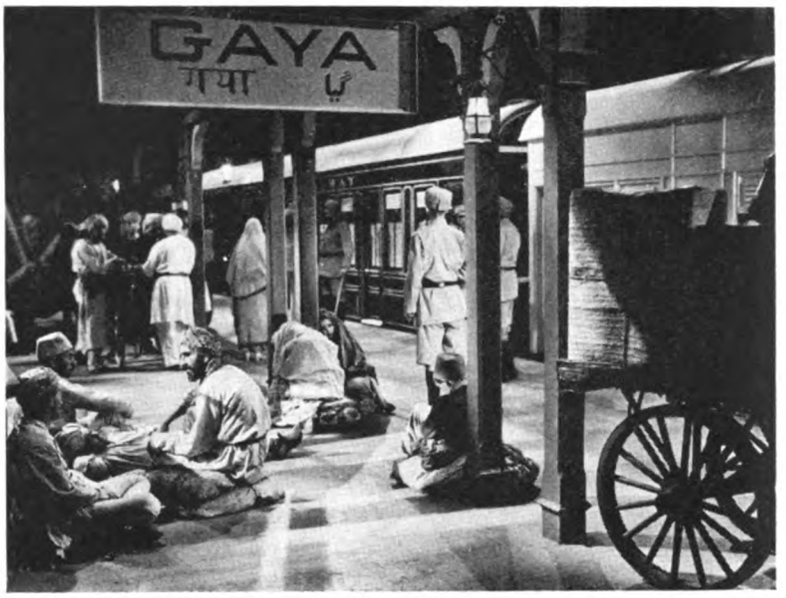
Since most of the action took place within the coaches, the roofs and ceilings were built demountable. To make one shot in the observation car, 60 spot lights, each weighing from 100 to 680 lb., had to be chain-hoisted to the car roof so as to adequately light the set and enable the microphone boom to follow the characters as they moved about in the car.

Railway trainmen and engineers are inclined to carp sometimes at obvious discrepancies from standard train practice as shown on the screen. One realizes that these devices are not subterfuges to "cheat" the audience. They are made necessary because of the peculiar limitations and requirements of cinematography and sound recording; they are carefully planned with the idea of advancing the action of the piece and enhancing audience enjoyment; they save time —in an industry which reckons its "overhead" at $2,500 per hour.

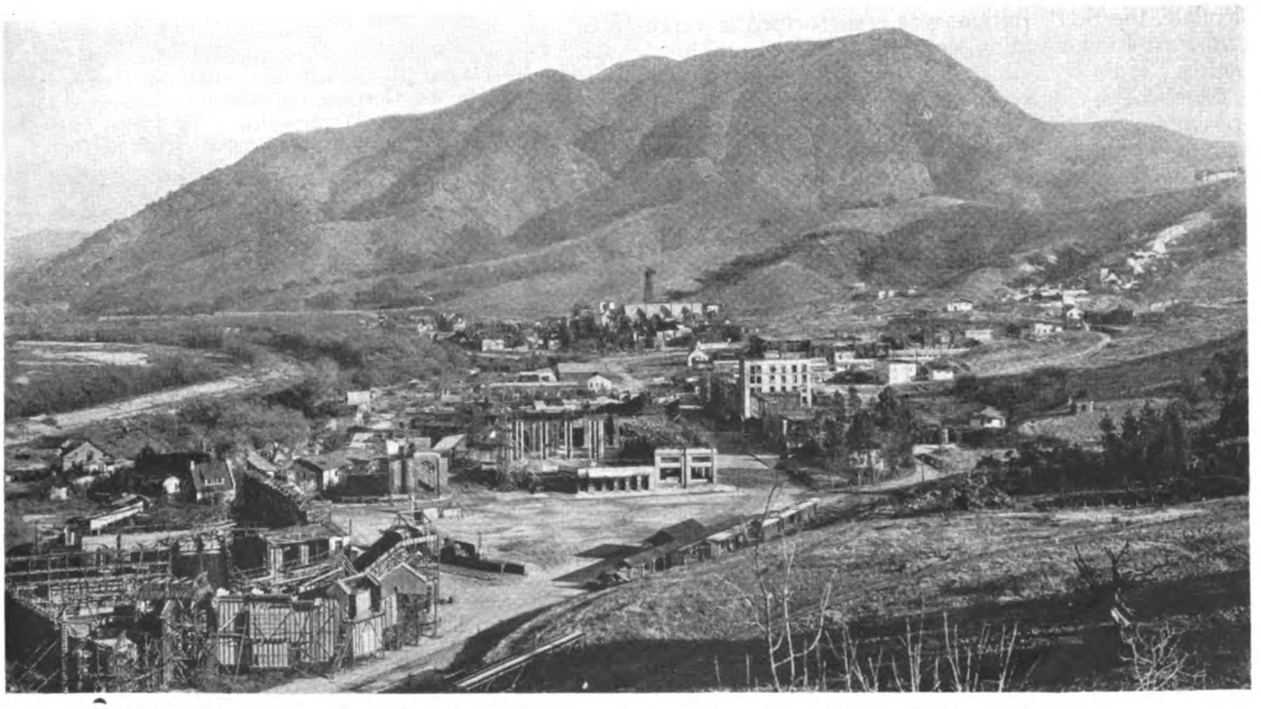
Occasionally, to be sure, scenes are of such a nature they must be shot "on location," as was the case with the current "Bombay Mail." Railway arrangements in this case were typical:

In consultation with the director of the picture Martin F. Murphy, production manager of Carl Laemmle's Universal Studio, decided that a number of real stations and trains were necessary. Negotiations were opened with the Los Angeles offices of the Southern Pacific Company. Officials of this company and Jack Lawton, studio location manager, inspected the proposed sites, agreed on the amount of trackage and trains required and the amount of camouflaging each station would have to undergo to resemble the regular way points between Bombay and Calcutta. (Every last detail must be authentic or East Indian "fans" would squawk.)

The S. P. leased a string of flats and furnished the studio art department with complete plans, specifications and photographs of these flats. The studio research department, which has on file complete "train data" ranging from travel articles, advertisements of equipment, etc., clipped from railway magazines, down to museum volumes, furnished the art department with this literature. From this data the art department ran



Scene in the "Bombay Mail," a Universal picture, shot at Chatsworth, Cal., on the Southern Pacific



Universal City with the railroad station, platform and cars in the center

off colored perspectives of the trains and stations for the director's o. k.

When approved, complete working drawings were put in hand. Coaches, etc., were rigged on the flats. When the work was completed by the studio mechanical departments a Southern Pacific locomotive was found which only needed a pair of front bumpers and removal of the pilot, plus some blinds on the driver's cab. Unemployed railroadmen who looked like Hindus were obtained by the casting director. The "prop" department furnished the train butchers with their betel nuts and other exotic East Indian confectionery.

Glendale, the S. P. station, was transformed to represent an East Indian station, and engaged for one night's "shooting," from 6 p. m. to 7 a. m. All S. P. baggagemen, dispatchers, call boys, etc., on regular duty who did not resemble wealthy English tourists, or who were not garbed as Hindus or Mohammedans, were instructed how to keep out of focus during the night.

Said Lawton, the studio location manager: "The S. P. furnished us with their schedule of bona fide trains arriving and departing throughout the night. In this case—as always—the railroad officials were most helpful. In policing the set, in first-aid provisions, and in every way, in fact, the railway lines co-operate with us absolutely 100 per cent."

Leroy Johnston, the publicity director of Universal Studios, estimates that over 10,000 people, attracted by the powerful lights, visited the S. P. station in the one night to watch the "vice-regal party" entraining and detraining from their snow-white coach, with their Punjab lancer escort in crimson tunics and the motley East Indian crowd.

Besides "Bombay Mail," forthcoming pictures will reveal every phase of railway operation to the public. Word comes that Metro-Goldwyn-Mayer is producing "Roundhouse Mag," with Marie Dressler in the title role; to be followed by similar themes from every major studio in Hollywood.

This cycle of railway entertainment has a certain significance to railwaymen. To some few skilled, experienced railway engineers or practical railroaders, it affords an opportunity to consort with the stars for a few weeks (at a comfortable salary and with "screen credit" to boot) as "technical director." But, more important, it is clear that the series will perform a helpful service to the railway industry as a whole: (1) in providing a helpful "tie-in" to the regular advertising and promotional efforts of the railroads, and (2) in helping to make the movies' 55,000,000 weekly audience "travel conscious."



A scene on the "Oriental Express" made in the Fox studio

River No Obstacle.—A little thing like the Danube river was no obstacle to the German railways in the erection of a new station at Tuttlingen, Wurtemberg. To make room for the station, the bed of the river was moved some miles.

Selling Katy Box Cars.—Unusual enthusiasm has attended the sale of worn-out box cars to farmers and others by the Missouri-Kansas-Texas. In dismantling 1,400 out-of-date cars last year, 75 furloughed employees were called back to work on the program. "Twenty truckers have applied for the job of moving the cars to the farms," remarked the Parsons Daily Sun, in an editorial commenting on the reclamation program, "and each truck requires two men. That is employment for 40 additional men. Many of the cars are remodeled when they get to the farms. They are set up on concrete foundations to furnish a hog shed below and feed storage above * * * * and everything else that a farmer needs in the way of barn or storage room * * * * every time a farmer remodels or remakes or paints, he buys some material with which to do the work. That means business." For a number of years it has been the Katy's practice, when freight cars reach a condition for retirement, to assemble them at the reclamation plant at Parsons, Kan., where, after the wheels and certain steel parts have been removed, the car bodies are offered for sale to farmers at prices varying according to the condition of the cars, for use as granaries or additions to barns, and, in rare cases, even as a place of residence. Last year the sale of cars was not confined to farmers, for 33 were acquired by the Citizen Conservation Corps for use as shelters in the Kansas encampment.

A Mechanically Cooled European Refrigerator Car

A NEW type of mechanically cooled refrigerator car, developed and operated in Europe by the Altek Company, Antwerp, Belgium, is being considered for use in this country, a feature of the cars being the unusually extensive and effective use of Dry-Zero blanket insulation.

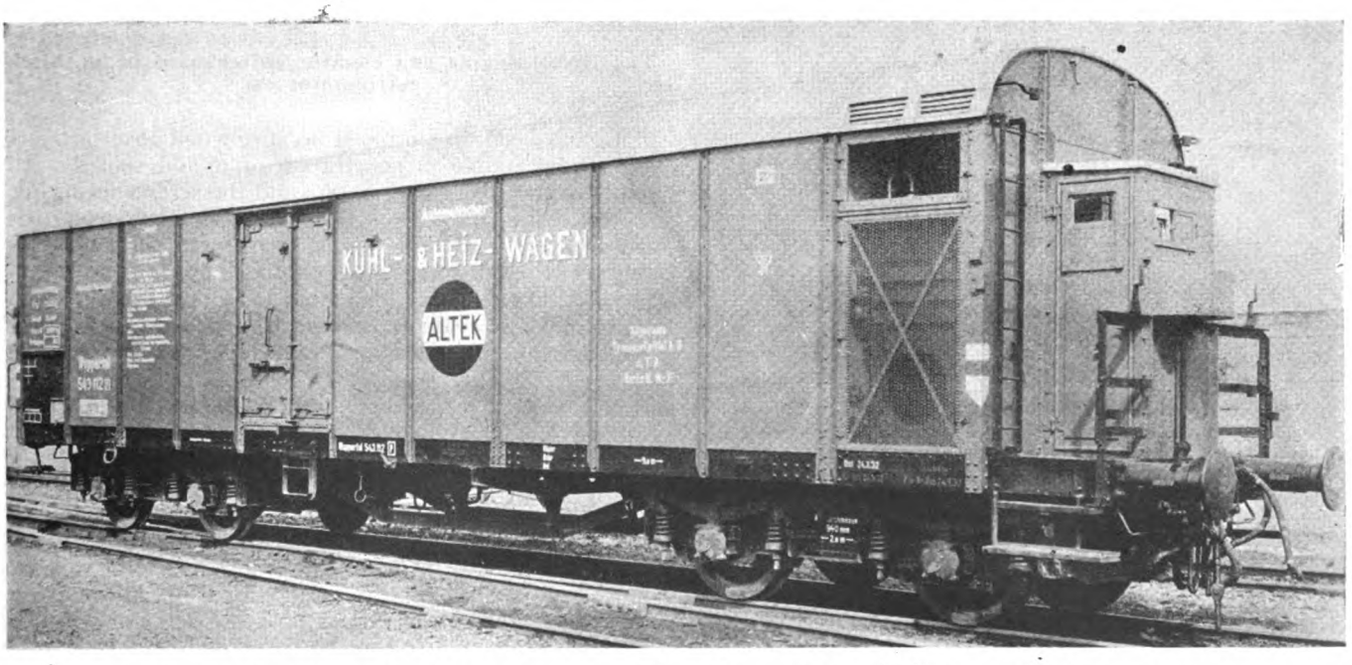
Altek refrigerator cars are unique in that they are the only perishable goods cars ever awarded certificates of capability by Lloyd's Register of Shipping. During the five-year period that Altek's mechanically cooled cars have been in service abroad, they have made an impressive record, with a loss of perishables of only 1.6 per cent. The refrigerating cost per car under maximum conditions is approximately 48 cents a day, according to Altek, and servicing costs also are said to be low. This performance is especially notable when the adverse conditions accompanying long hauls in Europe are considered, such as delays at national frontiers, the handling of the cars by train crews of diverse nationalities, and poor track conditions.

In addition to this performance record, there are several exceptional features that make the Altek design interesting to American refrigerator car builders and operators. One is the use of an 8- to 10-hp. full Diesel motor to operate the refrigerating unit comprising a two-stage ammonia compressor which is built to maintain, for 8 days without servicing, any desired temperature between 15 deg. and 60 deg. F., under external conditions, varying between 0 deg. and 110 deg. F. Another is the use of unusual provisions for insulation—7 in. in the roof, 6 in. in the walls and 5 in. in the floor. These thicknesses are composed principally of an extremely low conductivity material, specified to minimize refrigeration cost and to provide a large factor of safety for perishable loads in the event of delays or breakdown of the cooling equipment. If such occurs, Lloyd's insist that the car not be opened or unloaded but be carried to destination because they prefer to rely on the excellence of the insulation to protect the insured lading.

Both cork and Dry-Zero are used in unusual thicknesses to get the desired insulating effects in this car. Refrigeration is obtained from a Diesel-driven ammonia compressor

Both the refrigerating system and the design of the car proper are the result of Altek's own research. The decision to use an internal-combustion engine to operate a plant intended to run without attention in a railway car was considered a daring step by many engineers, although the most modern Diesels have reached a degree of reliability. In addition, certain safety devices have been developed which tend to protect the plant against any normal breakdowns. In fact, the simple and sturdy design of the plant, and the use of these safety devices, are largely responsible for Altek's obtaining Lloyd's certificates on the cars.

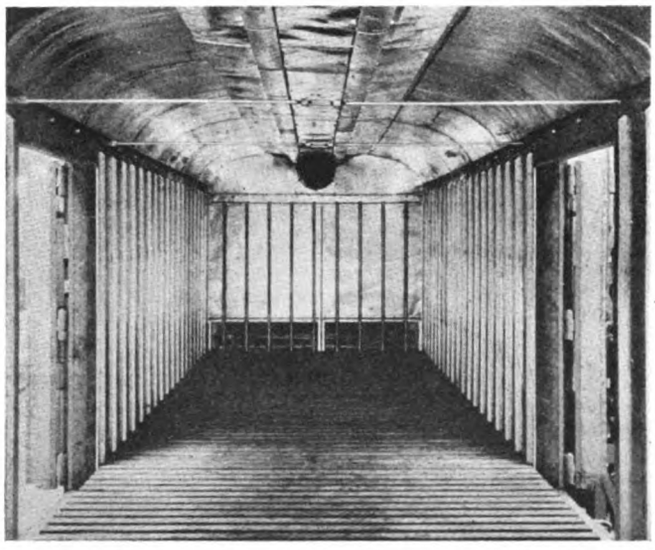
The Altek refrigerating plant is housed in a space 3 ft. 6 in. deep, extending across one end of the car. The two-stage ammonia compressor, of interesting and advanced design, is connected to the Diesel motor by a geared transmission. The remainder of the equipment consists of an evaporator in the form of a direct air cooler, an air-cooled condenser, a 3-kw. generator driven by V-belts from the Diesel fly-wheel, an electrically driven fan which circulates air in the car and an electric heating apparatus for use when particular cargoes require it. Fuel and water tanks are installed under the



An Altek refrigerator car—The mechanical refrigerating equipment is located in the compartment at the rear end of the car

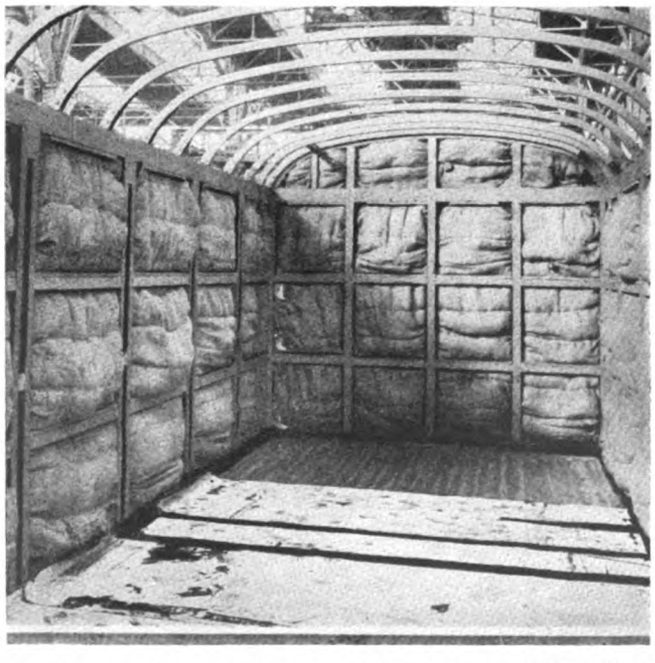
engine-room roof. A special control gear governs the automatic operation of the refrigerating unit. Although the plant is designed to operate without attention except at terminals, regular railway trainmen may be instructed to do emergency supervising, if necessary.

In the construction of the Altek car, which is generally



Interior view of an Altek refrigerator car. Chilled air is blown by an electric fan along an air duct under the roof. Ports in this duct distribute the air over the length of the car. The chilled air drops evenly over the cargo and is returned through the grid at the bottom of the bulkhead to pass again over the refrigerating coils

similar to American practice, the normal European method of bolting a wooden body to brackets attached to the side sills of the underframing is not employed. Instead, the steel superstructure with sheet steel end-walls is riveted to a sturdy underframe. To obtain great

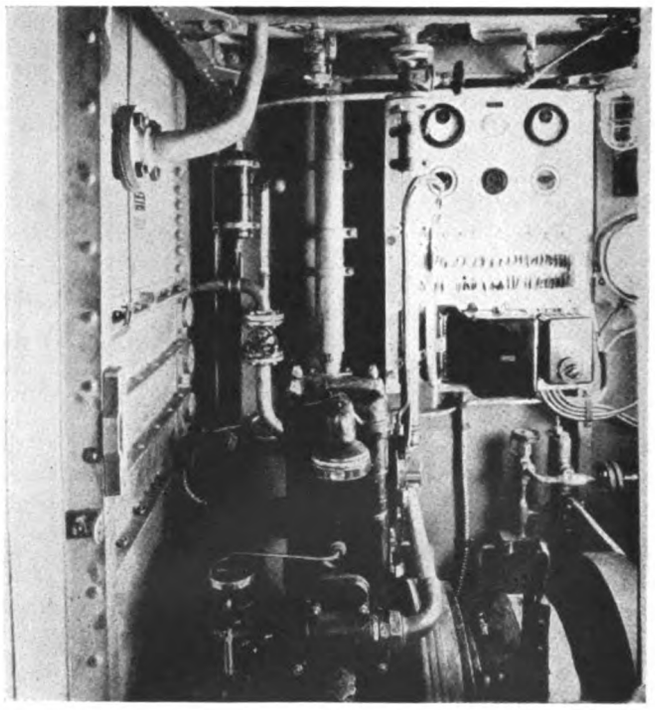


Altek car under construction—Two layers of Dry-Zero blanket have been placed inside the outer layer of cork slab insulation

rigidity, the steel structure of the side wall is designed in the form of a girder connecting strong corner posts and a rigidly welded door frame. This has been done to enable the cars to withstand heavy shocks such as those encountered when carrying produce from agricultural districts where the railways may be in poor condition.

The side sills and center longitudinals, made from equal channel sections, rest on two I-beam cross members, which are supported by a trussing gear. These, together with the heavy head stocks and cross bearers, give the whole underframe great strength and rigidity. The beams of the outer roof are bolted to steel carlines which, in turn, are connected by angles to the superstructure. Thus, all stresses resulting from the weight of the car, from cargo load and from the shock of braking and switching, are taken up by the steel structure of the car, while the wood body members, pillars and rails, primarily are intended to hold the insulation in place and to support the inner shell of the car.

The interior of the car is covered entirely with galvanized steel sheets. The use of timber for the inside



The Diesel engine and electric switchboard in an Altek refrigerator car

lining has been discontinued because wood absorbs odors and is susceptible to penetration of mould spores. All joints in the steel lining sheets and the screws fixing the sheets to the inner posts, roof beams and floor boards are securely soldered. It is, therefore, possible thoroughly to wash and steam out the interior of the cars and to render cargoes immune to contamination from merchandise previously carried, thus greatly broadening the variety of produce that may be transported in the same car.

The walls are insulated with 2 in. of slab cork and 4 in. of Dry-Zero blanket, the floor with 5 in. of granulated cork, and the roof with 7 in. of Dry-Zero blanket.

The siding and insulation are attached to the external steel framework. The outside sheathing is of composition or steel. Between the siding and slab cork are two layers of building paper. The outer post and rail are attached to the sills and the slab cork is set into the rectangular frames of this outer post and rail construction. The whole of this is then covered on the inside by a layer of building paper. Two Dry-Zero blankets 2 in. thick are next applied on the inner side. The entire

inside is then covered with a course of burlap and over that another course of building paper, the final lining being a galvanized sheet.

The doors are hung from the outside steel frame and have 6 in. of Dry-Zero insulation with four sheets of building paper, one against each wall and two between the blankets. The door frames are of light construction, and are inset with a spring wood strip covered with felt and canvas. The fastenings are of the Miner type.

The floor is composed of tongue-and-groove sheathing, covered with a water-proof canvas, upon which rests the floor framework. Into these frames are inserted 5 in. of granulated cork in rectangular burlap covers. Next comes a ¼-in. rubber membrane, which rises 8 in. up the walls, and lastly the metal flooring, which is soldered to the inside metal lining.

The roof carries 7 in. of Dry-Zero blanket insulation, and is designed to reduce heat transmission through the framing to a minimum. The inner series of roof beams is bolted to sockets attached to the inner framework of the walls; the metal lining is screwed to the inside of these roof beams. Between the roof beams and above the metal lining are laid a course of building paper and a blanket of Dry-Zero. Then, for the entire length of the car and over the roof beams, lining and sections of Dry-Zero, are laid two Dry-Zero blankets covering the entire roof area, which are secured by battons to the inner wood roof beams. Over these are placed the outer, steel roof beams which are bolted to the outside framework of the car. Between these come additional Dry-Zero blankets, laid transversely over the car. Lastly come the wood planking and outside canvas.

The sides of the car and the outer roof are made of tongue-and-groove American pinewood boards. All the roof boarding is covered with a bituminous roofing felt made in one piece. Under the inner roof of galvanized sheet steel is an air duct made of the same material. Air is drawn by a fan from the bottom of the car over the coils of the direct air cooler, passed down this air duct and blown through small holes into the cold chamber. The cold air drops evenly over the cargo to the grilled floor and is returned at the bottom of the bulkhead to pass again over the evaporating coils.

Altek cars are reported to have hauled more than 2,000,000 tons of perishables with a loss of only 1.6 per cent. This record has been made despite the fact that shippers often select the Altek cars to handle the most difficult type of ladings. For example, an Altek car carried without loss from Pietra Ligure, Italy, to London, 175 cases of a variety of peach that never before had been transported even as short a distance as to Milan without a 30-per cent to 50-per cent loss. The peaches carried by Altek arrived in London in excellent condition and all were sold. Choice game, such as hare and pheasant, shipped in Altek cars have repeatedly brought premium prices in European markets.

Electric Starting of Diesel Engines

By Frank Guillot*

IN the original designs of Diesel-electric locomotives the question of starting the Diesel engines was not regarded as containing serious problems; compressed air starting was adopted. The fact that air starting had long been the general method employed in starting stationary engines naturally brought this method to the fore in the design of the first Diesel-electric locomotives. It was, therefore, decided to use a small auxiliary air equipment for starting purposes only. This equipment consisted of a small compressor driven by a gasoline engine and auxiliary reservoirs with the necessary valves and piping. While this arrangement was passably satisfactory, it had certain disadvantages such as delays sometimes occasioned by failure to get the auxiliary engine running immediately, especially after long periods of idleness or in extremely cold weather, time required to pump air up to the required pressure, and other troubles usually likely in any equipment used a relatively small part of the time.

The necessity for carrying gasoline as fuel for this starting equipment was another decided disadvantage on a locomotive otherwise free from inflammable materials.

These disadvantages, each seemingly small in itself, were in the aggregate sufficiently annoying to warrant the adoption of a method which would afford greater ef-

* Locomotive Transportation Engineering Department, General Electric Company.

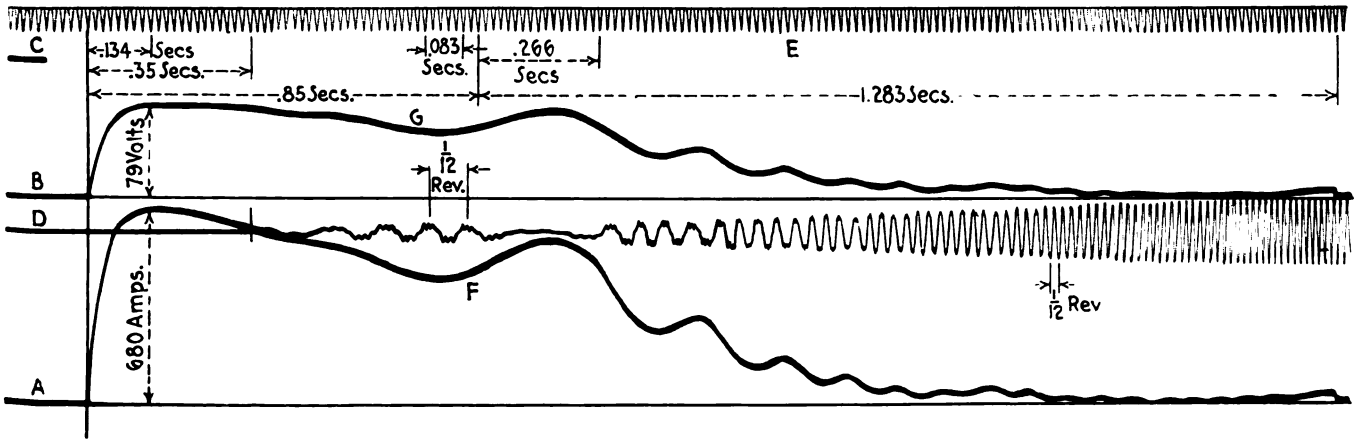


Fig. 1—Oscillograph record showing current, voltage and time required for starting (Battery No. 1)

ficiency through simplification as well as time required to get the locomotive under way. It was evident that the advantages of simplicity, ease of maintenance, and speed in getting under way could be accomplished by the use of electric starting.

Inasmuch as storage batteries were already carried on the locomotive for lights and control energy, it was merely necessary to increase their capacity and, as the switches required were of the same design as those already in use, the number of supply parts necessary was really reduced. It was necessary to add to the series winding of the generator to obtain the necessary starting torque when using it as a motor in starting the engine. The charging of the storage battery was accomplished through the auxiliary generator.

Some recent tests of the electric starting of a 300 hp., 6-cylinder, 4-cycle Diesel engine, wherein the records were taken by means of the oscillograph, brought out details of the actual requirements of power and starting time. When it is considered that the time cycle of starting ranges from 1½ seconds to 2¼ seconds, when the engine is warm, and the current, voltage and time values are given for each fraction of a second during this cycle, it will be seen that accuracy of result is obtainable, which would not be possible if recording or direct reading instruments containing damping features are used, where the limited speed of the human eye must be depended on to observe rapidly changing results.

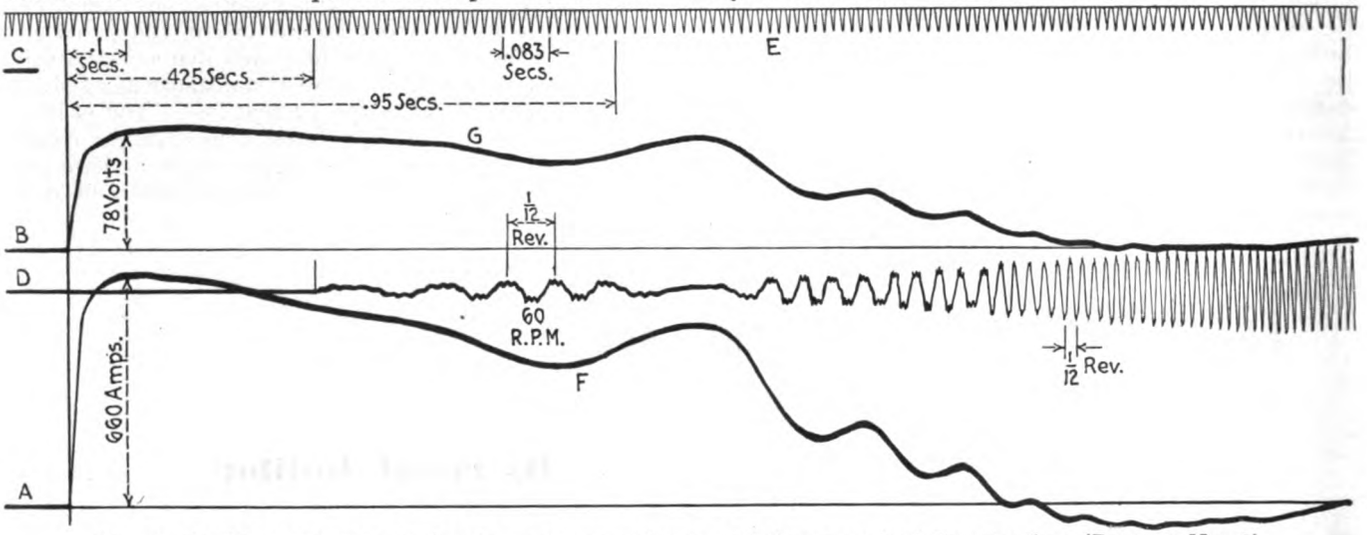


Fig. 2—Oscillograph record showing current, voltage and time required for starting (Battery No. 2)

Oscillograph records of tests using different type batteries are shown in Figs. 1 and 2. The line *A* in Fig. 1, indicates zero amperes, *B* zero battery volts, *C* open circuit battery volts, and *D* revolutions of the speed indicating alternator. The vertical lines at the top of the record indicate the 60-cycle timing wave. When the starting motor is thrown across the battery, the rise of current and corresponding drop in voltage are indicated in curves *F* and *G*.

A simplified sketch of the connections used for the engine starting tests is shown in Fig. 3. Two different batteries were used during the tests, and from the diagram, it may be seen that the voltage measured was that across the battery terminals. Curves *G*, Fig. 1 and Fig. 2, therefore represent drop in battery voltage, with increase of load, a measure of battery performance. Open-circuit battery voltage is approximately 114. Thus when the battery voltage drop is 79, as indicated in Fig. 1, the voltage across the terminals of the generator, which acts as a starting motor, is 35.

When the starting switch is closed, the increase of power is continuous until the engine starts to move. For calculating purposes, the point, at which the engine starts to move, is taken as the breakaway value, at which point the current reached 680 amp., the reduction in battery voltage, 79, and the voltage available across the terminals of the starting motor, 35.

The time from the moment current was applied until the engine started to move was .134 sec. From this point the current begins to fall until the first compression stroke is encountered, at which time the current begins to rise and continues to go up until the piston reaches approximately top dead center on the first compression stroke when the current falls and voltage increases until the next piston starts its compression stroke, and so on.

The revolutions were recorded by means of a small alternator geared to the crank shaft of the engine in the ratio of four to one. The speed may be calculated in conjunction with the 60-cycle timing wave by recording the cycle wave of the alternator, which is a six-pole machine. Each revolution, therefore, gives three cycles, and as its speed is stepped up in the ratio of 4 to 1, 12 cycles of the wave represent one revolution of the engine, or the distance between crests 1/12 revolution.

Observing the revolutions line, *D*, it will be noticed that the line remains straight for a period of .35 sec. after the circuit has been closed, when it begins to take on the form of a wave. This is the point at which the speed has increased sufficiently to cause the revolutions indicator to register. From this point on, the wave gets more pronounced and the distance between crests decreases, indicating increased speed until the firing

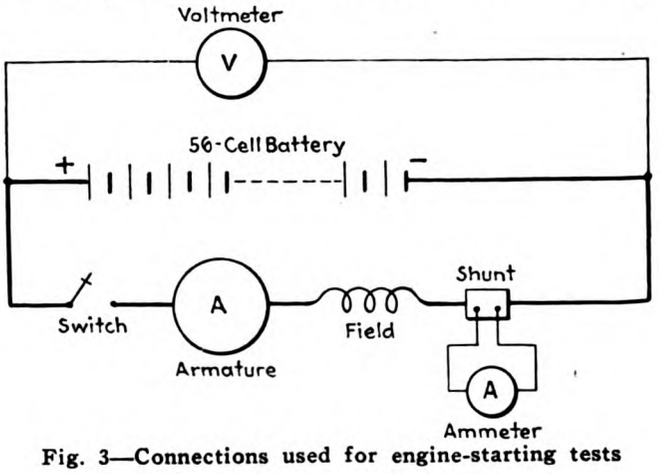


Fig. 3—Connections used for engine-starting tests

point is reached. A maximum speed of 60 r.p.m. is obtained while the engine is being motored, at which speed firing begins, which is in .85 sec. after the starting circuit has been closed. Observing the revolutions wave a distance of sixteen cycles of the timing wave, or about .266 sec. after firing begins, it will be seen that the engine speed decreases at the moment of firing. Fuel injection starts a few degrees before the piston reaches top dead center on the compression stroke. At the low speeds used for starting, combustion begins before top dead center is reached, which momentarily retards the speed. This condition decreases as the speed increases, injection being timed for proper combustion at normal speed.

After firing begins the speed rapidly increases to 257 r.p.m., which is reached just before power is cut off the starting motor, which occurs 2.133 sec. after power was applied.

In most cases the engine would continue to run if starting power were cut off immediately after the engine starts to fire, but in this case the control is arranged to require the starting circuit to remain closed until the engine has reached a sufficient speed to build up a predetermined lubricating oil pressure. The reason for this is that the engine is protected against low lubricating oil pressure by means of a switch in the control, which is operated by oil pressure. The function of this pressure switch must necessarily be annulled during starting, which is accomplished through interlocks on the starting contactor.

Streamlined Rail Car on Great Western in England

THE Great Western Railway (England) has recently placed in service a streamlined rail car driven by a 130-hp. heavy oil engine, which resembles in appearance a seaplane float. It was developed as a result of wind-tunnel tests which, it is said, indicate a reduction of the head-end wind resistance to one-fifth that of a similar flat-ended car. The new car will operate experimentally in local services and will cover about 218 miles a day.

The car is 62 ft. long and 11 ft. 4 in. high. It weighs 20 tons and has been designed for a maximum speed of 60 m.p.h. Seating capacity is for 69 passengers. The car is driven by a 130-hp. heavy oil engine using non-inflammable fuel. This engine is almost identical to those fitted in some of the London buses.

The sides of the car extend to within a foot of the track so that practically the whole of the vehicle, including wheels, is enclosed in a streamlined body. Everything possible has been enclosed, even to the head and tail lamps, controlled from the driver's seat, which are fitted flush with the body.

The engine, radiator and driving parts are located under the floor on one side of the car near the middle doorways, and can be easily inspected or repaired by merely removing an inspection cover.

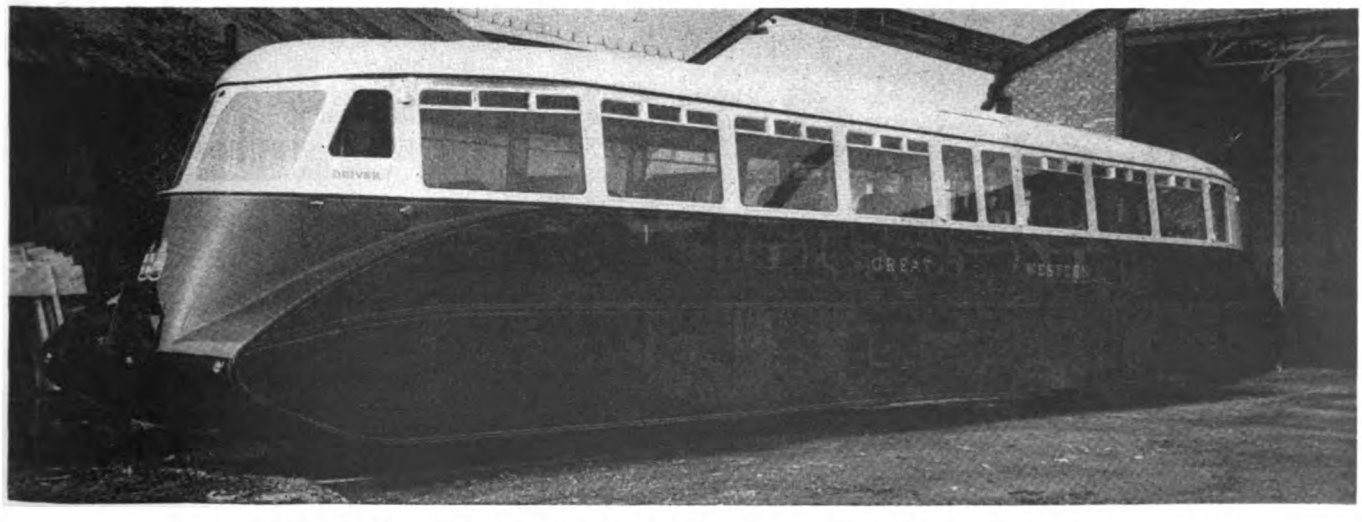
Transmission of power from engine to wheels, and brakes and controls, which are duplicated so that the car may be driven from either end, are identical to those used on a great many of the modern cars and buses.

Interior of the Car

The entrance to the car is at the center, through double doors which open into a vestibule 5 ft. wide. Two large compartments lead off from this, each with a center gangway. On each side are seats ranged back to back, upholstered in pleated brown leather and fitted with cellular rubber cushions to give the maximum amount of comfort. Racks for light articles run along the side of the car.

The interior is decorated in brown and green. The sides of the car are covered in mottled green Rexine and the roof in cream Rexine. The floors are covered with Insulboard to deaden noise, and green lino and mottled green carpets. All the woodwork is walnut. Flush-fitting ceiling lights and lights on the under side of the luggage racks are provided. The coach is heated by hot-water heaters fed from the radiator. There is an emergency lever which stops the engine and applies the brakes when pulled down. Each compartment is fitted with a clock and speedometer. A microphone enables the guard to communicate by loud speaker either with the operator or the passengers.

The car is decorated in the company's colors—chocolate and cream. A crest appears at each end and on either side are the words "Great Western."



Streamlined rail car in service on the Great Western Railway, England

EDITORIALS

Fighting To Get Back Business

To railway men there can be no more inspiring spectacle than the splendid fight that is being made by the railroads to regain both passenger and freight business. This should mean much to the employees of the mechanical department in improved employment and more stabilized conditions. The depression was bad enough, but with it the railways have had to suffer severely from competition on the part of highway and waterway carriers, who, unhampered by the restrictive regulations to which the railroads are subjected, have also had their rights-of-way provided and policed for them by the government, whereas the railways have had to pay heavy taxes on rights-of-way which they have had to furnish and maintain at their own expense.

Much to the consternation of the motor-transport carriers, the railways have in several instances adjusted their rates in the attempt to meet this unfair competition. They have also speeded up their freight services and in some places are providing pick-up and store-door delivery service. While, under the business conditions which have existed in recent months, it is difficult to determine the value of these measures, there seems to be no doubt on the part of railway executives but that they are being effective in regaining business and strengthening the position of the railways.

Fast freight trains, such as the "Maine Bullet," which operates over the Boston & Maine and New York, New Haven & Hartford between Portland, Me., and New York; the "Speed Witch" of the New York, New Haven & Hartford and the Pennsylvania, which furnishes overnight service between Boston, Mass., and Baltimore, Md.; the "Blue Streak" of the St. Louis-Southwestern, and the "Katy Comet" of the Missouri-Kansas-Texas, operate on schedules closely approximating those of passenger trains, and are largely relieved of intermediate terminal delays. Because of this speeding up it is of first importance that the equipment be kept in such prime condition as to avoid possibilities of delays in transit. The mechanical department, therefore, has a real responsibility in doing its part in helping the railroads successfully to meet and overcome the competition of the motor transport and waterway carriers.

Signs of Distress

Signs of the strain created by the drastic retrenchments in expenditures for maintenance of equipment during the depression are clearly evident in the twenty-second annual report to the Interstate Commerce Commission of the chief inspector of the Bureau of Locomotive Inspection covering the fiscal year ended June 30, 1933, which has just been issued. The percentage of steam locomotives inspected which were found defective has been declining steadily for several years. From 24 per cent for the year ended June 30, 1928, it had dropped to 8 per cent for the fiscal year ended June 30, 1932. For the past fiscal year it rose to 10 per cent. The number of locomotives ordered out of service, the total number of defects found, the number of accidents and the number of casualties all have likewise increased for the first time within this period, although the number of locomotives for which reports were filed and the number inspected are the smallest for any year within the period.

The number of accidents caused by parts of the steam locomotive increased from 145 to 157, or 8.3 per cent, while the number of resulting casualties increased from 156 to 256, or 64.1 per cent. That this apparently alarming increase in casualties is not truly an indication of correspondingly alarming equipment conditions, however, is clearly evident from the fact that 102 injuries and three deaths were among nonemployees, as compared with six injuries only during the preceding year. Thus, only five employees met their death in steam locomotive accidents in 1933 as compared with nine in 1932, and 154 employees suffered injuries as compared with 150 during the preceding year. The large increase in nonemployees is due in the main to a single accident in which 84 passengers were injured by blowing steam and broken glass.

The report does not, therefore, indicate an immediately alarming increase in the number or nature of the defects, accidents, or casualties. Some apprehension may well be felt, however, from the fact that for the first time since 1923 the trend has reversed and conditions are definitely worse than for the preceding year. Without an increase in maintenance programs, irrespective of the trend in the volume of traffic handled, these conditions may be expected to get steadily worse. It is evident that locomotive conditions are approaching the danger point.

Honesty— Code or Character?

Among the prolific crop of proposed codes of fair competition which are being engineered through the N. R. A., many of which are now awaiting the President's signature, are a goodly number which have been prepared for the regulation of various branches of the railway supply industries. When all of these codes have met their final approval and become effective, railway purchasing officers will, for a while at least, have a busy time getting clearly associated with each of these groups its own particular variety of unfair practices, of which it proposes to purge itself through the administration of its code authority.

The provisions regarding sales and unfair trade practices written into the respective codes reveal some of the evils which have crept into the relation between these manufacturers and the railroads. Some codes contain no reference whatever to practices affecting the relations between seller and buyer. Others reflect the attempts on the part of the industry to relieve itself of pressure on the part of the buyer to secure provisions in contracts which may be considered entirely ethical even though not highly advantageous to the seller. Still others frankly aim at practices which not only must be considered unethical under any reasonable standard of business ethics,

but which also involve deliberate corruption of government representatives or trusted representatives of the purchaser.

It is a sad commentary on the business relations between some of these industries and the railroads that provision against corruption in specific terms has to be written into their codes of fair competition. It must be said also that falling back on regulations which have the force of law can never be a satisfactory substitute for common honesty in business relations. The latter can only be maintained when honesty as the basis of personal conduct prevails among the men in both the buying and selling industries. Indeed, regulations, imposed from without where personal standards of conduct should prevail, tend further to remove conscience as a factor in business conduct and substitute for it—sharp practice.

Problems of Supervision

The past four years have taken heavy toll of officers and foremen in the mechanical departments of the railways. In the natural course of events a certain percentage of these men would have been retired from active service because of old age, failing health, death, or other reasons. As a matter of fact, this percentage, even under normal conditions, would have been reasonably high, because most of the men in such positions are fairly well advanced in years. Even during the years immediately preceding the depression, however, the supervisory forces of many roads were being disturbed by shifts and eliminations caused by the more intensive utilization of locomotives, including the longer runs which eliminated or decreased the load on some division points and placed a greater emphasis upon enginehouse operations and running repairs. This tendency was further intensified by the centralization of heavy repairs to equipment in a smaller number of shops.

On top of this came the heavy falling off in business in the years 1930-33, inclusive, during which time many supervisors were demoted or furloughed. Some of these men, unfortunately, will never resume their former positions. A certain percentage has gone into other lines of work entirely outside the railroad field and cannot be induced to return to railroad service. Others, for a variety of reasons, will either not return to railroad service or will not be put back into their former positions. It is not surprising, therefore, that today, even with only a reasonable pick-up in business, questions, of which the following is typical, are challenging the attention of the mechanical department executives: "How can we best coach and train the supervisors who are new to their positions on how to render the most satisfactory service?"

No one other administrative question has been brought so forcefully to the attention of the editorial staff of this publication during the past month. We talk much of the "new deal" in economic, social and political affairs. The railways, likewise, are facing new and changed conditions. They will have to fight to the very limit to increase the efficiency of operation, in order successfully to meet competition from other types of carriers. It is more or less generally recognized, also, that still higher standards of freight and passenger service must be attained. This will require a maximum of managerial ability on the part of all departments. Indeed, it promises to require a standard of ability and loyalty on the part of the supervisors far beyond anything that has been expected in the past.

This problem of increasing the effectiveness of supervision is not a new one; indeed, it has been very much to the forefront during the past quarter of a century, as will be evidenced by a survey of the past volumes of this publication. We have had much to say about foreman training, including special courses of study, staff conferences, foremen's and supervisors' clubs, etc. Several roads in recent years have approached the problem in different ways and with excellent results, even though in most instances such activities have been dropped or have lagged somewhat during the past two or three years. Excellent facilities of various sorts are available for those who realize the emergency and have the will to take advantage of them.

Then, too, although the railroads differ materially in most of their operations from the average industrial organization, valuable suggestions may be gained by studying the practices of the more advanced of these industries in improving and strengthening their supervision and increasing production. Certain of these industries have secured excellent results by going outside their organizations to secure expert advice and counsel; others have deliberately selected and trained carefully picked men to specialize on problems of management and production. Just as it is important periodically to dress and sharpen tools, so it is equally, if not more important, methodically and scientifically to study and take measures to bring the supervisory staff to the best possible condition satisfactorily to discharge its duties. This is true even under normal conditions, but is particularly so—as conditions change and competition becomes more intensive.

Do We Know Our Unit Costs?

We hear a lot of discussion from time to time about the vital necessity of reducing the cost of repairing locomotives but almost every time one makes an attempt to reduce the discussion to practical facts and endeavor to arrive at some conclusion as to what moves should be made to bring about such a desirable objective there appear to be so many varying factors that it is extremely difficult to consider the problem in its entirety. Possibly the very fact that so many mechanical men try to look at the problem in all its phases is the reason why it appears complicated. Most any modern machine looks complicated in spite of the fact that it is actually made up of a number of comparatively simple parts. So it is with many modern problems. If we take them apart and examine the "pieces" one by one sooner or later the one shows up that is causing most of the trouble. To remedy the trouble once it is found is a relatively simple matter.

It has been stated before, and is worth stating again, that we are spending more money on the railroads of the United States for repairing locomotives than is being expended for any other single item of operating expense and, because it is the item of greatest expense, locomotive repair costs should logically demand the greatest attention in an effort to reduce them.

It may also be worth while to re-state the factors entering into this problem. Generally speaking there are four, all equally important and inter-dependent: First—the selection of the proper type of locomotive to meet the demands of the particular service for which it is to be used; second—careful locomotive design with a view to efficient operation and economical maintenance; third—adequate repair facilities of a type that will permit the

repair of power in keeping with the demands of traffic and at the lowest possible cost and, fourth—a broad appreciation of the importance of this problem on the part of railroad officers and supervisors; in other words, intelligent management.

A few months ago, in an editorial in these columns, this problem was discussed and the suggestion was ventured that the railroads had not made the progress in reducing repair costs that should have been made. One railroad officer took issue with that suggestion and said that, in his opinion, we were unfair in not giving the railroads credit for the accomplishments that have actually been made over the past ten or fifteen years. Unappreciative as it may seem of past accomplishments the cold fact stands out that, regardless of what has been done in the past, the mechanical department of the future is going to have to do many things that have never been done before and do them in an entirely different way. The policies and achievements of the past have been based upon the revenues of an expanding industry—the decisions of the future, in all probability, will have to be tempered by the knowledge that the period of rapidly increasing revenues has ended.

Those mechanical officers who do not hesitate to look into the future are gradually becoming convinced that possibly we do not know as much about the economics of the problem of locomotive repairs as we should. Questions arise daily to which there appears no immediate answer and, what is more disconcerting, concerning which there appear to be no tangible facts on which to base a conclusion. Is it possible that many of the major problems of the past have been solved by more or less rule-of-thumb methods? Is it possible that we have achieved successes in the mechanical department primarily because, up to now at least, the revenues of the industry have usually been more than sufficient to meet our needs? Possibly the reason why we haven't made greater progress is because we have, up to now at least, been denied the vitalizing influence of keen competition. Be that as it may, the railroads are now faced with competition and the mechanical department, because its expenses represent the largest items in the budget, is going to have to meet a logical demand that it find ways and means of reducing those expenses.

It would seem ridiculous to suggest that any mechanical-department officer does not know from year to year and month to month what the comparative costs of operating his department are. Without a doubt they all do. Suppose we were to go a step farther and ask whether one class of locomotive on a given railroad is more economical to operate than another—assuming that they are both capable of hauling the same tonnage over the same territory. Most mechanical officers—not all—can answer such a question as this. If you were to attempt to state, without fear of contradiction, that one shop on your road is more efficient than another or than one on another road the answer would become more difficult. Assuming that you know that one type of locomotive in a given service is more economical to operate than another, can you state with positive assurance why this is true and can you state with equal assurance what should be done to correct the condition on the type that does not show up so well in service? Is it possible on most railroads to produce records showing the comparative repair costs of individual locomotives over a period of, say, 10 years?

The only excuse for injecting such questions as these into a discussion of the locomotive repair problem is that attempting a frank answer to them may lead to the discovery that the railroads have, in the past, done a rather thorough job of keeping comparative cost records *in a general way* but have apparently been satisfied that a detail knowledge of unit costs is not necessary.

How can intelligent decisions as to future repair programs be made without an intimate knowledge of the actual costs in connection with every part of every locomotive on the line? Such a knowledge is required in order (1) to select the proper type of locomotive for a given service, (2) to design with a view to efficient operation and economical repairs, (3) to determine whether the repair facilities are adequate for the demands of traffic at the lowest possible cost and (4) to make it possible for management to be intelligently applied. If this be true then unit costs, compiled in greater detail than has heretofore been the practice, are the key to open the door to lower costs of locomotive repairs.

NEW BOOKS

A. S. M. E. Power Boiler Code, 1933 Edition. *Published by the American Society of Mechanical Engineers, 29 West Thirty-Ninth street, New York. 314 pages, 5½ in. by 8 in. Bound in cloth. Price, $2.50; to members, $2.*

The A. S. M. E. Boiler Construction Code comprises eight sections. In this volume are included but three sections which pertain to the construction and inspection of stationary boilers for the development of power. These are: Section I, Power Boilers; Section II, Materials Specifications, and Section VI, Rules for Inspection. Stationary boilers as here considered include portable and traction boilers. The Code applies only in part to certain special forms of boilers, such as those of the forced-circulation or flash type. Suggested rules covering existing installations are included in the Appendix, which is explanatory, and not mandatory, in enforcing the rules of the Code. The rules for the inspection of materials and boilers (Section VI) are suggestive only and do not form a part of the Boiler Code.

The Book of Stainless Steels. *Published by the American Society for Steel Treating, Cleveland, Ohio. 631 pages, 6 in. by 9 in. Board binding. Price, $5.*

Part 1 of this book describes the Production and Fabrication of heat-resisting and corrosion-resisting alloys; Part II, Properties of the Typical Alloys; Part III, Requirements of the Consuming Industries, and Part IV, Classification of Trade Names. Each of the chapters has been written by an outstanding engineer in the particular branch of the industry, among the authors being E. J. W. Ragsdale, research engineer, Edward G. Budd Manufacturing Company, who discusses Spot Welds and "Shotwelds."

Introduction to Railway Mechanics. *By George V. Lomonossoff, D.Ing.E.h., M.I.Mech.E., M.V.D.I.; formerly professor of railway engineering and economics in Kieff and St. Petersburg, and research associate of the California Institute of Technology. Published by the Oxford University Press, 114 Fifth avenue, New York. Price, $3.75.*

This volume of 180 pages presents in slightly altered form the subject of a series of lectures at the California Institute of Technology. It applies mathematical analyses to the various problems of motion as they affect railway track and equipment, such are: Motion of the Wheel; Propelling and Resisting Forces; Railway Track; Railway Vehicles; Motion Along Curves; Locomotives; Parasitic Motions; Mechanics of a Train and Dynamics of a Wheel.

THE READER'S PAGE

Answers Reader's Questions

To the Editor:

On The Reader's Page of the November *Railway Mechanical Engineer,* under the title of "What Is Your Opinion?" a reader raises the question as to whether it is permissible to re-light-weigh and restencil foreign cars and bill owner. The correspondent specifically mentions a steel-underframe car with wood superstructure and designates the first reweighing when the car is one year old. Of course, there would be no difference as to whether it was the first or any subsequent reweighing, nor the class of car, except as provided for in section (1) of Rule 30.

Rule 1, paragraph (a), says: "Each railroad is responsible for the conditions of all cars on its line." Rule 30, first paragraph, section (B), says: "All freight cars, except as otherwise provided in section c, must be re-light-weighed and restencilled periodically as follows * * *." (Then follows the classification of cars and the time that may elapse between reweighings. The exceptions otherwise provided in section (C) are tank cars and live poultry cars.)

Rule 30, section (G), first paragraph, says: "When a car is reweighed and restencilled the owner must be promptly notified of the old and of the new light weights and load limits and the place where and date when reweighing and restencilling was performed. The proper officer to whom these reports should be made will be designated in The Official Railway Equipment Register."

Rule 107, Item 284, says: "Weighing and stencilling all per-diem cars, net—$4.15."

The rules do not specifically state that foreign cars may be reweighed and restencilled and bill made against owner for same, but all references to the matter indicate that it is a proper practice. Furthermore, it often becomes necessary to do this. A car may leave its home line just before it is due to be reweighed and remain away for many months. It would be impractical to allow it to go without the proper attention in this regard and it is not being done. So, your car away from home with the weight stencilling out of date is any man's meat.

Second question, "Can foreign cars be sent to the repair track for air-brake cleaning after 14 months, or must the 15-months' limit be used if the brake is not defective?" Section (b), Rule 60, as revised in Supplement 1 to the 1933 A. R. A. Code, says: "Cylinders and triple valves not cleaned within 15 months, as indicated by standard markings, must be cleaned. After the expiration of 12 months, if the car is on the repair track for other work, the air brakes may also be cleaned. After the expiration of 14 months, air brakes may be cleaned regardless of whether or not car requires other repairs."

Of course, this refers to foreign cars, as there is no restriction on performing this work on home cars, provided they are not allowed to run over the 15 months.

The charge for this work is $4.73, as per Item 13, Rule 111.

T. J. Lewis.

[Note.—Car Service Rule 11, of which Interchange Rule 30 is a reprint, was revised, effective January 1, 1934, in that portion of Paragraph (1) Section B which pertains to the re-weighing of cars. This was done for the purpose of synchronizing the dates for the re-weighing and stenciling with those for the cleaning of air brakes and the repacking of journal boxes. Attention is directed to this revision in connection with the second paragraph of Mr. Lewis' letter.—Editor.]

Heating 18-Car Trains

To the Editor:

In the November, 1933, issue of *Railway Mechanical Engineer* there appears an article by W. J. McClennan with reference to the possibilities of heating an eighteen-car passenger train:

It has been the writer's experience, in connection with the design of steam heating equipment for heating of trains drawn by electric locomotives, that the limitations at present imposed by virtue of size of steam-heat train-line pipe (2 in.) and the size of connectors between the cars determine the length of train that can be properly heated.

It has been observed that approximately 20 lb. pressure drop occurs between the pressure reducing valve at the locomotive and the train-line connector at the rear of the tender or electric locomotive. Further, in order to assure reliable steam flow through the train, the steam pressure at the end valve of the train must be not less than 5 lb. The pressure drop experienced throughout the train depends upon the outside temperature and train speed and will range from 12 lb. to 20 lb. per car.

It has been found that, with a given initial steam pressure at the head end of the train, the pressure drop throughout the train increases rapidly with train speed, as indicated in the McClennan article. This is due to the excessive condensation experienced at the connectors because of wind velocities at these points due to train speed.

For trains made up of from twelve to eighteen 70-ft. day coaches the maximum quantity of steam that can be put back through the 2-in. steam heat line is represented by

$$S = N\left(4.31 - \frac{N}{12.5}\right)$$

where S = total steam to train, pounds per hour.
N = number of day-coach cars in train.

The pressure drop through the train is represented by equation—

P = 0.7W — 4.97 for eighteen 70-ft. day-coach train.
P = 0.546W — 4.69 for fifteen 70-ft. day-coach train.
P = 0.40W — 10.0 for twelve 70-ft. day-coach train.
P = pressure drop.
W = steam consumption, pounds per car hour

On the basis of the above data, it will be seen that, where the car consumption rates approximate 350 lb. per car hour, due to severe weather conditions, not more than twelve 70-ft. day coaches can be handled with the present 2-in. steam-heat line. Also, that where eighteen-car trains are to be handled, the hourly steam consumption rate per coach must not exceed 225 lb. per car hour, thereby indicating that the limit of ability to properly heat trains is based on quantity of steam that can be handled through the steam heat train line.

Robert N. Miller,
Assistant Engineer, Pennsylvania.

With the Car Foremen and Inspectors

Alec and Dave Are Back Again

By T. J. Lewis

DAVE was busy on his interchange the other morning when he heard Alec call:

"Dave! Come here a minute."

"Wait a minute," Dave answered.

Dave was going that way anyhow and he could tell by the sound of Alec's voice that it was something out of the ordinary that Alec wanted him to see, so he'd take his time and aggravate Alec a little. Dave was inspecting his interchange cars as he went, and glancing in Alec's direction, all he could see was the rear end of Alec protruding past the side of the car.

Dave took his own time and when he came up to Alec, leisurely asked:

"What seems to be the trouble, old man?"

Naturally, Alec felt just a trifle of resentment at Dave's lack of interest and blurted out:

"I'm just setting one back to you for a loose wheel, that's all."

Dave pretended great surprise. "Loose wheel," he yelled. "Why, who ever heard of setting a whole car back just for one loose wheel." "Why, Alec, remember when you was a kid you used to cry to ride on your daddy's wagon—and all the wheels it had were loose?"

"Well enough," said Alec, "but this old wagon of yours is not going to ride on this road with one loose wheel."

By this time Dave had arrived at the car in question and glancing at the sealed door, then at the Inter-Road ticket on the corner of the car said: "Uh huh, loaded car too, Alec. Why is it you always want to pick out loaded cars to find trouble with? Now there's that old empty right next with your O.K. mark on the corner. I'm asking you, if you just had to set a car back, why couldn't you find something the matter with it and set it back and let the load go?"

While Dave was "ragging" Alec in this manner, Alec was still down on his knees, over the wheel, squinting at it, inside, then outside, doing his best to determine if the wheel was really loose. He realized that Dave was trying to "get his goat" and, of course, that made it easier to do. Dave, for his part, knew just as well, or better, than Alec did, just how much of that sort of stuff would be required to find the end of Alec's temper, so he made no immediate move to look at the wheel himself, but stood aside and continued to prod Alec.

"Business is business, you know, Alec," he said. "Loaded car is real business, empty may be or may not be, so you better think again——."

"Who the devil could think," Alec growled, "with all that racket going on? I know what I am going to do about this wheel——"

"O, well, then why did you call me down here," Dave cut in. "Besides I was just going to suggest that it might be easier to change your mind than to change a pair of car wheels. More profitable too, maybe." "Course," he added, as an afterthought, "it depends on whether you got a mind to change."

"No," said Alec testily, "what you was just going to do was wait and see what my decision was and then you was going to try to decide different and undertake to make me agree with you unless my decision was entirely in favor of your old railroad, which is what you can decide right now, because I am giving the car back to you and, welcome."

"What?" Dave exclaimed in surprise. "Wait a minute, Old Timer, wait a minute. What in the world's the matter with you this morning? Has the Old Man been riding you with another hot letter? What you been up to now? Giving somebody else a defect card for brake shoe keys, or something? Ha, ha, ha," Dave laughed. He knew he'd touched a sore spot in Alec's mind that time.

"O, never mind all that," said Alec, "here's your car. You can do what you please with it, and when you make it safe to handle, give it back to us and we'll run it. Don't want to see it any more 'till then."

"Huh!" Dave snorted, "is all that so? All just because that wheel looks a little like it might be loose and maybe a little more like it might not be loose, huh."

"Depends on who's doing the looking and how contrary they are I guess," Alec answered.

"O, well," said Dave, getting down to take a good look at the wheel. "Does look a little like it might be leaking a little oil through the hub, don't it?" "However," he continued, "that's the only indication in the world you can see. It's not out of gage and the best you can see behind the journal box it looks all right to me."

"Sure, it looks all right to you because it's going from you or is wanting to," Alec rejoined, and continued: "Did you ever notice, Dave, how much better a disagreeable thing looks going from you than coming to you?"

"O, yes," said Dave, "a bull dog, f'instance."

"How about a car with a dangerous defect?" Alec asked.

"Same thing," Dave mumbled, still on his knees, looking at the questionable wheel. A thought struck him and he quickly turned and said: "Now if that blamed car you mentioned was in my out-bound train it'd be mighty different. A defect card's sorter like that too."

"Well, you're not doing any good squinting at that wheel," Alec reminded him.

"Really, Alec, I believe I'd run that wheel," Dave began.

"No use to start any argument, Dave," Alec bridled. "We're not supposed to try to use any judgment of our own in a matter of this sort. In fact we're not supposed to have any judgment to use—the office folks who never see any car wheels have that. Our job is to do the looking and if we see oil on a wheel-fit we're to assume that it is probably loose and if it's probably loose it's probably dangerous, so there it is."

"Wait a minute," Dave said. "This is a truck defect and it's up to you to run it, repair it or transfer it, just which ever you please. I haven't forgotten that damned old empty you folks delivered on my track with a broken wheel flange, and when our switcher pulled it out, it derailed and fell over and knocked a hole in one

of your old cars and I had to give you a defect card for the damage. No, sir! You'll not catch me in another mess like that. Besides, this wheel is half worn out and, no doubt, been all over North America without causing any trouble. Now you want to condemn it just because it's got a little oil on it that gives you an excuse for trying to believe it's loose."

"Yes," said Alec, "but Dave, that was different. In that other case it was your own empty car that had to go home to you, was delivered on your own track with an owner's defect. Now this car doesn't belong to us,—it's just one you're trying to give us and it's not safe to handle and we won't have it."

"Safe enough I claim," Dave came back. "As I said, it has been everywhere else but here and this place is no different from others, counting contrariness and stubbornness out. If the wheel is loose as you want to claim, it's purely an owner's defect, delivered safe on your own tracks, so it's straight up to you to handle it any way you choose." Dave delivered this last shot with an air of finale that he intended to put a finish to the whole matter, and added, as he pretended to turn and start away—"that's all I've got to say about it, Alec."

"In that case," Alec growled, "I won't expect to hear a word from you about this." So saying, Alec flourished a "Set Back" card in Dave's direction and turned and proceeded to tack it on the car.

"Look here, Alec," Dave objected. "I haven't got a single pair of wheels of that capacity in my whole outfit, and I believe you knew it and are trying to set this car back on me, just in order to mess me up."

Alec had started to fill in the card, but as Dave said this, Alec turned and stood staring at him with a look of incredulity and after a moment said, "Why, Dave, I'm in the same fix. Course I've an order in for them, but it hasn't been filled. Don't know what's the reason,—haven't got 'em at the shop, maybe."

"Oh, that's what's making you so scary here in your old age, is it? Well, I'll tell you Alec, the fact that you haven't got the material with which to make repairs is no good reason for refusing to accept a car and by all the rules in the book this car belongs to you and you know it. Just turn right over here to the fifth paragraph of Rule 2,"—as Dave said this he had pulled his Rule Book from his pocket, thumbed the leaves over and was pointing a long, grimy finger at the paragraph in question—"it says right here, as plain as the grease on that wheel hub, that 'Loaded cars offered in interchange must be accepted, with the following exceptions (a) to (e), inclusive.' Now read from (a) to (e) and if you find anything about a loose wheel in 'em I'll eat 'em."

Dave considered that he had Alec on a hot-spot, and his argument, sure enough, was getting under Alec's skin; however, he was too well acquainted with his old adversary to hope that he would take the "count" so easy.

Alec realized that it was no time to let himself get out of hand, so, taking a moment in which to pull himself together, he said, in a tone of voice and with a glance that indicated that Dave's ignorance was hopeless, "Dave, you worry hell out o' me," and continued, "of course, I know it's not in the paragraphs (a) to (e), inclusive, but just turn right over there to page 13 and read Article 9 and learn something, if you can." As he said this he was getting his own rule book out, and turning to the place mentioned, read: "Any other defects which can be repaired under load, or if car is safe to run and safe for lading, the receiving line to be the judge."

Dave gave not the least indication that he heard, or that he even knew Alec was reading, so Alec persisted: "Hear that, don't you Dave, listen again, 'or if the car is safe, the receiving line to be the judge.'"

"Aw, go to hell," Dave snapped and turned away, as he chewed on a match stick to relieve his irritation. After a moment he said, "No danger in that car, Alec, and you know it."

"Don't know anything of the kind," Alec persisted, and continued, "the blamed thing 'ud have to go around a plumb new-moon curve to get to my rip track and that wheel would be hard against the rail all the way. I'm on the receiving end of this job and I don't propose to take any risk when I don't have to."

Their attention was attracted to a switch engine working just across in Dave's yard and Alec had a happy thought and said:

"Why, Dave, there's Joe making up his shop run now. Why not get him to back right in here when gets ready to go and pick this old patient up on the rear end and he can take it to North Yard Shop and your Old Man will put the wheel in and have it ready by the time Joe gets his shop switching done and he can bring it right back." And as an afterthought, he added, "Straight track all the way, too."

"Guess I better do that," Dave grumbled and strode off to see Joe about it.

So the trouble seemed to be over.

THE car did not get back that day as both boys had expected, but when they arrived at the interchange next morning, there it was, back on Alec's track. Dave was there first and when Alec walked up Dave said:

"Well, Alec, here she is, safe and sound with a new wheel in 'er. Hope you're satisfied now."

"Yep, everything's pretty," Alec admitted, but added, "see a little oil on that one too,—guess it got on there in the shop."

"Sure," Dave answered, "that pair of wheels were just fitted up yesterday. You know I told you the press had been broke down."

Dave felt that Alec should have a mild bawling out for his over-caution, so he proceeded with it this wise:

"Now that you've got it like you want it Alec, I just want to tell you a thing or two. I met Jim Hooks, the wheel-press man downtown last night and he told me,—what do you reckon? Why, he said it took over two hundred tons pressure to unseat that blamed wheel, as scared as you was of it. He said also that there was not the least bit of sign where any oil had leaked through that hub. Whaddayou think of that? You know Jim's a careful man too,—been on that job a long time. No, sir, you can't fool Jim about a loose wheel."

"O, well," said Alec, "nobody's trying to fool Jim, nor giving him any thought anyway. Jim's got his own job to attend to at the shop and ours are up here,—that's all the difference."

"You know, Alec, I told you all the time the wheel wasn't loose," Dave persisted, "and Jim said him and the shop foreman both agreed that it wasn't loose, before he ever put it in the press."

By now Alec was good and hot, so he snapped back,—"they did, did they? Well, then why in the hell did they ever put it in the press? Would you put a wheel in the press and take it off if you knew already it was not loose? Of course, you wouldn't. If they are so damn smart they ought to have our jobs and let us work in the back shop where we could afford to know everything and be responsible for nothing. Would them smart fellows be willing to tell the general foreman that

they pressed off a wheel for being loose that they knew already was not loose? No, and they'd have a duck fit if you told him so. I've always noticed that it's the yap furthest removed from responsibility that knows most and is the bravest about what he would do, if he was going to do anything at all, which he generally ain't. As for them smart fellers that make the rules for us to go by, if we go by 'em and don't take any chances then we're blocking business, but if we try to look the other way and let a thing pass and get the freight spilled all over the right-of-way, that's criminal carelessness and we're due to be discharged.

"So the way it seems to me, Dave, is that if you want to be on the right side, all the time, you just got to beat them guessing all the time which is, of course, impossible."

While Alec was unloading this, he had knelt down by the wheel and was closely looking at the bit of new oil on the hub, when, spat! a new drop of oil landed square on it.

"Well, I'll be damned!" he blurted, "look here, Dave, just com' ere, will you," and following the line with his eye, from the hub straight up to the car floor, he got an eye-opener.

By this time Dave was down on his knees also, looking up to see what it was all about. Alec reached up and slowly touched his finger to a small splinter that protruded straight down from the car floor, then looked at his finger and held it for Dave to see. It had a fresh drop of oil on the tip of it.

"Well, don't that beat anything you ever saw?" Dave asked, and continued, "Why, Alec, that's a nail hole through that floor. Yes, sir, some scamp pulled a nail out and this car is loaded with empty oil barrels and you know how they always leak oil all over the floor, and that's just what's happened. Well, I'll swear." They both got up and stamped around awkwardly and said nothing for a moment. They were about as cheap feeling a pair as could be imagined and could not keep it from showing in their looks.

Dave was never known to keep quiet for very long, so he said:

"Well, Alec, that's a good one on you, ain't it?"

"On me, hell," Alec exploded, "no more on me than it was on you and if you think so, just tell your Old Man about it and see what he thinks."

"Tell the Old Man nothing," Dave exploded. "What I've noticed is that he is too blamed wise already, without me telling him anything, 'specially about a job like this." As an afterthought, he added, " 'Course, I know you'll tell it everywhere, Alec, ha, ha."

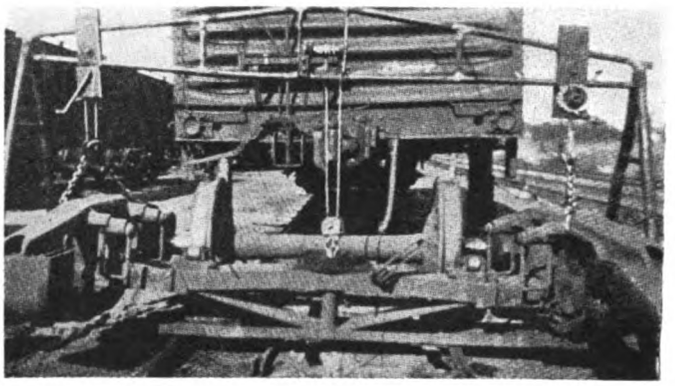
"Aw, you go to hell," Alec growled and turned slowly away to go about his work. He realized that he would feel better if he could get off by himself.

Car Truck Assembling Devices*

By W. J. McCloskey

THE weight of modern truck side frames and the importance of application at the proper angle in relation to the wheels presents a hazard to highly polished journals meriting the most skillful and conscientious handling. In one of our local shops we employ a comparatively simple device which suspends the bolster and carries both truck side frames free of the journals at right angles. The entire structure weighs about 80 lb. and is made largely of scrap material available at the local shops. This material consists of 1¼-in. pipe cut to the proper length and fabricated by means of welded joints, the lifting mechanism consisting of brake ratchets and dogs, also reduction gears salvaged from scrap 50-ton jacks.

This arrangement affords sufficient power to raise the truck parts with little effort on the part of the operator. The device eliminates the use of jacks in changing wheels with the exception of those used in raising the car; it reduces the operating time of changing wheels approximately 30 per cent; eliminates all damage to



Device used in assembling car truck sides and bolsters easily and without damaging the journals

dust guards and the possibility of damaging the highly polished journal due to the truck side being removed or applied. It also holds the truck side in convenient working position to clean out boxes, remove or apply dust guards, and clean out well holes. The approximate weight of this device, as stated, is 80 lb. and it can easily be carried by two men to the point where the wheels are to be changed.

Frame and braces are made up with welded joints, either acetylene or electric, as local conditions warrant. The cross bar is level, while the top support is arched, and cross braces are welded in to give additional strength. Winches on the sides, that lift and carry the truck sides, are made up of discarded jack gears and dogged with a brake ratchet. These travel on the straight cross bar on a roller which, in this case, is an old sheave wheel. The cranks are welded on permanently. Brake wheels could be used in place of cranks, but would add to the weight. One-quarter inch wire cable is used down to the light chains that are coupled to the truck sides and bolsters.

This device is very sturdy as constructed and, by using the gear reduction, sufficient power is provided to raise the bolster and side frames at one time so the wedges, brasses and springs can be removed. We never think of maintaining any light jacks for truck work since these devices were installed. All the jacks needed for wheel changes are those used to raise the car.

*Abstracted from a paper entitled "Train Delays on Account of Hot Boxes," presented by W. J. McCloskey, general car foreman, Illinois Central, before the regular monthly meeting of the Car Foremen's Association of Chicago, held Monday evening, November 13, at the La Salle Chicago.

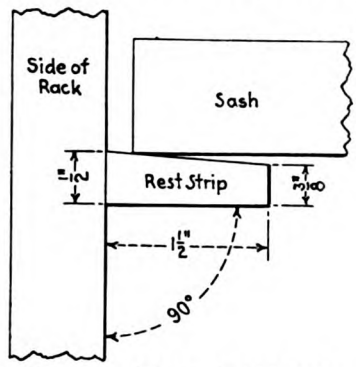
ANOTHER USE FOR OLD FREIGHT CARS.—According to the Wall Street Journal, several discarded freight cars standing on an unused sidetrack in upper Manhattan, N. Y., gave two women an idea. They secured permission to make these cars livable, cutting windows, finishing the interiors, and putting in each car a few plain articles of furniture. One car was fitted up as a kitchen and dining room where the women serve meals to their tenants—50 of them—at $6 a week for board and "room."

Sash-Rack Skid

THE adjustable sash-rack skid, shown in the illustration, has been used for several years at the Milwaukee passenger shops of the Chicago, Milwaukee, St. Paul & Pacific, to handle sash within and between the sash and door, trimming, etc., departments, and has given efficient service.

The skid has an overall height of 64 in., width, 39½ in., and length, 66½ in. It is designed for movement by hand or power lift trucks, accommodates various sized sash in a horizontal position, and can hold two different-sized sash on the same load. One man can handle the device.

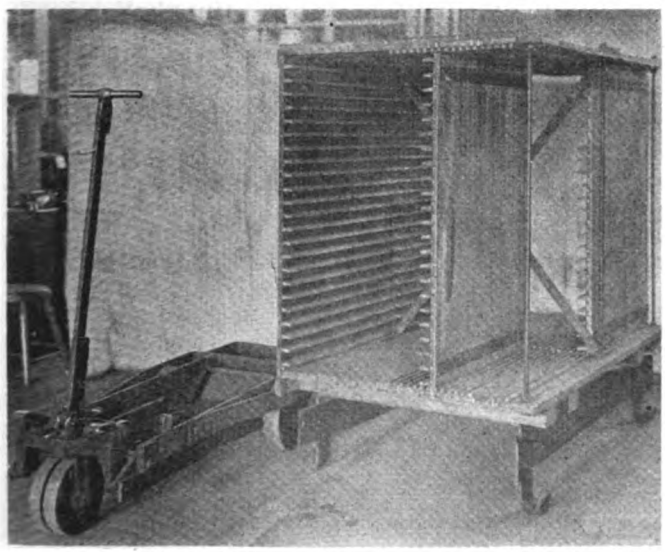
The base, or skid proper, is made of four wrought-iron straps bolted together. Two straps, each ½ in. by 4 in., are bent so that each strap forms two legs and a cross piece. Two other straps, ¼ in. by 6 in., tie the first two pieces together to form the skid, and also serve



Details of the rack side and skid rest arrangement

as side guides for the lift truck. The rack proper is bolted onto the cross members of the skid.

The rack is an open-ended box, consisting of top, bottom and two sides. It is made of tongue-and-groove wooden flooring and sheathing, and is 46 in. high, 39½ in. wide and 66½ in. long. One side of the rack is made



Sash-rack skid used at the Milwaukee passenger-car shops of the C. M. St. P. & P.

into two independent parts, each part or semi-side 32½ in. long, and it can be pulled out and slid into any one of the 17 grooves to provide proper spacing for the sash. Three ⅝-in. diameter rods support the top of the rack on the side that has the two semi-side pieces. Also, two ⅜-in. by 1½-in. wrought-iron straps, criss-crossing each other, placed inside and at the center of the rack, help to keep the rack rigid.

The inner walls on each side of the rack are covered with tin to prevent the metal edges of the sash from damaging the rack and thus getting dirt onto newly-painted sash. The wooden strips upon which the sash rest are screwed onto the sides of the rack. Each strip is cut on a bevel, as shown in the sketch, so that only an edge of the sash rests upon the strip, thus minimizing the damage to freshly-painted sash. The strips are spaced so as to accommodate sash up to 1¼-in. in thickness.

The rack, shown in the illustration, holds 44 sash, a complete car set of inside or outside sash. It will hold sash varying in width from 15 in. to 34½ in. A larger-sized rack skid, similar in design to this one, is employed for the wider sash found in dining and parlor cars.

The sash-rack skid is designed to afford a maximum protection for the sash, plus a minimum expenditure of labor for handling. When the sash is painted it occupies a horizontal position on the bench or in the spray booth. By having the sash occupy a horizontal position in the skid-rack, they are more easily handled because unnecessary turning is eliminated. The horizontal position also prevents "runs" in the paint and varnish while the sash are drying. The sash are better protected against dirt, dust and damage when enclosed by an open-ended box, and yet plenty of air is afforded for the drying of paint and varnish. Having the rack capable of accommodating various sized sash, and two sizes in one load, permits full utilization of each rack-skid, and minimizes the number of skids and shop floor space required.

Pertinent Questions On Hot Boxes?*

1—Do you make special efforts to detect cut journals in cases where they are cold when inspected, and there is no exterior evidence of recent heating?

2—What action do you take in cases where journals are discovered cut with no evidence of recent heating and running cool at the time of inspection?

3—What disposition do you make of so-called cold cut journals discovered in connection with regular service treatment on your repair track when there is no evidence of recent heating?

4—How do you decide whether or not a journal bearing on a cold journal is sufficiently defective to warrant removal? This applies to train yard inspection and not Rule 66 service on repair track.

5—Do you condemn journal bearings on account of what appears to be excessive end wear? If so, what is your condemning limit?

6—Do you, in connection with service treatment on repair tracks, condemn journal bearings found with cracked lining which apparently adheres tightly to the shell?

7—Do you inspect for waste grabs in train yards? If so, how do you proceed toward detecting it?

8—What method of servicing journal boxes in terminal train yards, etc., do you consider most productive?

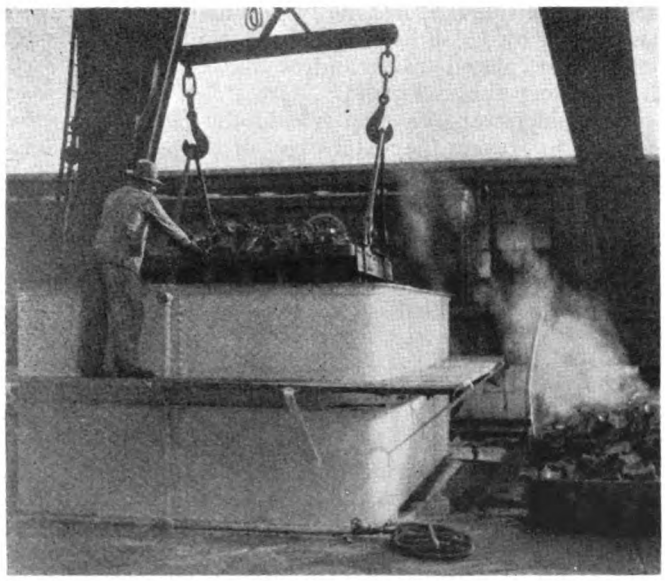
9—To what extent is free oil used in your train yards?

(Concluded on page 26)

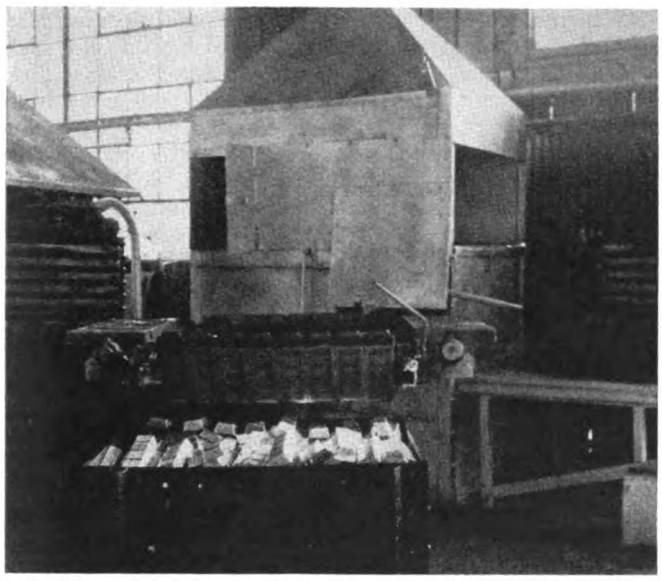
*These questions were appended to a paper entitled "Train Delays on Account of Hot Boxes," presented by J. W. McCloskey, general car foreman, Illinois Central, before the regular monthly meeting of the Car Foremen's Association of Chicago, held Monday evening, November 13, at the LaSalle Hotel, Chicago.

Reconditioning Worn Car Journal Bearings

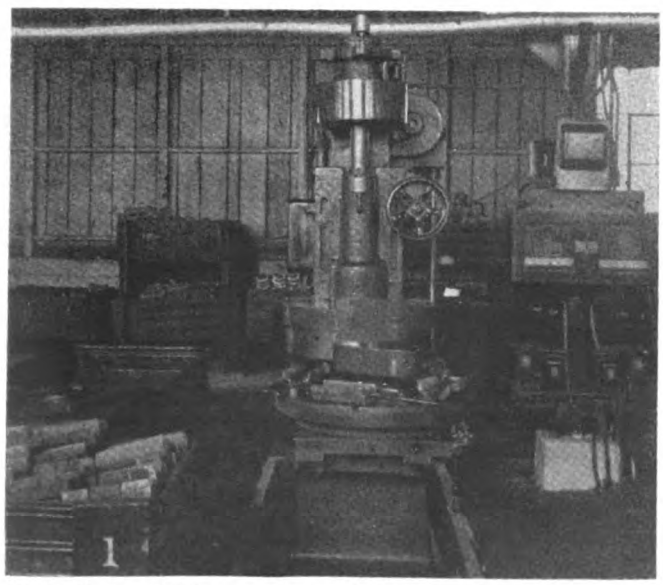
*By J. W. Lemon**



Basket of worn bearings as sent to lye vat for cleaning



Melting-out pot and table for removing babbitt from machine cuttings



Method of grinding car journal brasses on surface grinder

TO the average railway employee, worn car-journal bearings removed from equipment units represent scrap value, but to the trained mechanical employee they represent a great potential saving, and how to realize that saving by placing the bearings in condition at minimum cost for re-use is a problem that merits careful analysis and study.

The practice of relining bearings in company shops is not being generally followed, it being the practice on most railroads to ship their worn bearings to the foundry for scrap value and purchase new bearings. We have on the Missouri Pacific, however, demonstrated by actual practice that relining of our accumulation of worn journal bearings under scientific methods has effected considerable economy and has produced a bearing that is just as satisfactory for application as a new bearing. Of course, to carry on the reclaiming of worn car journal bearings, the necessary and proper equipment must be considered, and we have developed a modern, scientific method of operation, which may be summarized as follows:

Worn journal bearings, removed from equipment, are shipped in from outlying points to concentration point, where they are loaded into a basket of several tons' capacity and placed in a cleaning vat, where they are thoroughly cleaned. This basket of bearings is then placed on the washing platform, where the remaining residue is washed off, and the bearings are then classified by separating the different sizes, which are 4¼ in. by 8 in., 5½ in. by 10 in., and 6 in. by 11 in. Those bearings not suitable for relining are placed to one side to be disposed of as scrap, which amounts to between 25 and 30 per cent under the requirements of American Railway Association tolerance. When separating and classifying the different sizes of bearing shells, they are placed in lift-truck boxes and taken from the cleaning platform to the boring machine.

Removing Babbitt from the Shell

This machine has been developed especially to accommodate the operations necessary to bore the babbitt from these bearings, at the same time cleaning the shell. This machine is so designed that the bearings are placed on a turret table, which passes under the boring bar. The table is raised up and the straight end of the bearing is faced off. The machine is so operated that it next feeds by hydraulic pressure, boring out the babbitt metal, and at the same time boring out the bearing, the last operation being to face the fillet end. This rotation is continuous, as the table operates at such a speed that a bearing can be applied to the chuck while the boring operation is being done. The timing of this machine is such that it provides easy movement for handling and passing 100 bearings through it per hour.

Leaving the boring machine, the shells are taken to the surface grinder, where they are again passed through a classifying process, separating any further bearings which do not come under the tolerance gages, and then the flat surface of the bearing is ground off. This machine was also developed from an old vertical milling machine and is especially equipped for this particular operation. It is so timed and the application of the bearings to the table is such that a man can operate the

* Formerly superintendent of shops of the Missouri Pacific at Sedalia, Mo., and recently appointed mechanical superintendent of the Texas and Louisiana lines of this road, with headquarters at Houston, Tex.

machine and at the same time classify the bearings by the use of the tolerance gages and pass a bearing through the machine every 25 seconds. This machine is especially designed to grind the brasses all of equal thickness, this being necessary on account of bearings being accumulated from all foundries over the country, with a slight variation of sizes being encountered, which would seriously interfere with the bearings passing over the babbitt mandrels.

Leaving the grinding-machine table, the bearings are again placed in lift-truck boxes and are next taken to the tinning vat, which is especially designed and equipped with modern heat control. The bearings are placed in the soldering metal and thoroughly tinned with a solution of muriatic acid and sal ammoniac, this metal being heated by an oil burner, accurately controlled at from 675 to 700 deg. F., by a heat-control instrument.

After being thoroughly tinned under this predetermined temperature, the bearings are immediately passed to the mandrel table, where they are clamped with an air device, on the rotating table, and passed under the pouring spout of the babbitting furnace, the temperature of which is also controlled automatically at from 700 to 750 deg. F.

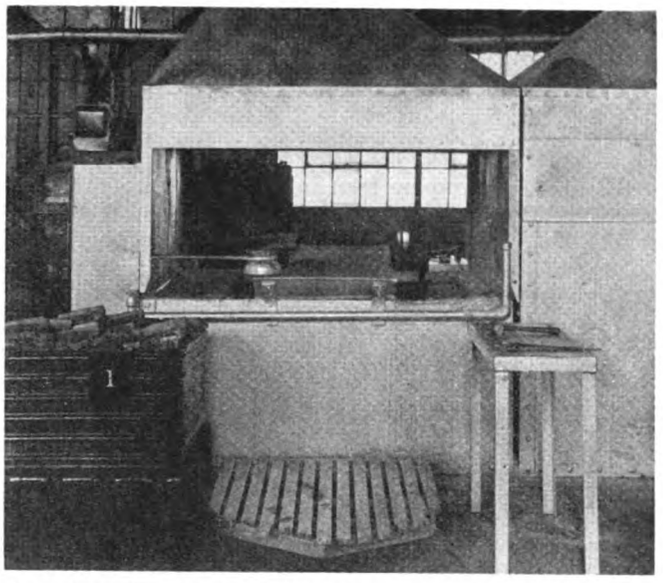
Proper Metal Proportions Important

One very important and scientific requirement in the handling of this important job is to know that the relined journal bearings have the proper specified metal applied, which should contain the following: Lead, 85.0 to 88 per cent; antimony, 8.0 to 10 per cent; tin, 3.0 to 5.0 per cent; arsenic, 0.2 per cent, max.; impurities, 0.5 per cent, max. In order to know that the bearings are being relined with this predetermined specification, a special agitating paddle has been applied to the babbitting furnace in order to keep the metal moving, as the heating is a refining process and if the metal is allowed to stand quietly, it will cause the lead, which is the heavier, to settle to the bottom, the antimony next and the tin, or lighter material, on top. With this method of agitating the metal, we have the assurance that all bearings relined under this method contain metal of the proper analysis.

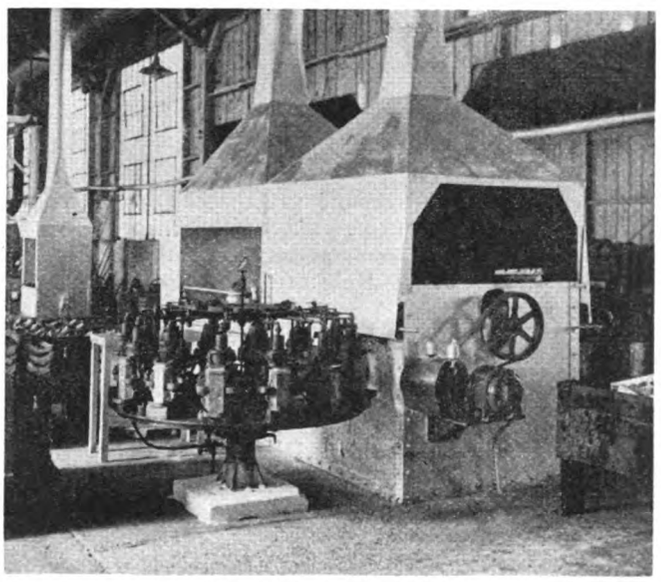
The proper tinning and the proper pouring at a predetermined temperature must be considered as an important part in the reclaiming of journal bearings, and this is carefully handled, due to the fact that the bearings are babbitted immediately after coming from the tinning furnace, and the babbitt applied while the bearing is still at the tinning temperature.

Leaving the babbitting mandrels, the bearings are placed in lift-truck boxes and are again sent to the boring machine for final boring. They pass through this specially designed machine at the rate of 100 bearings per hour.

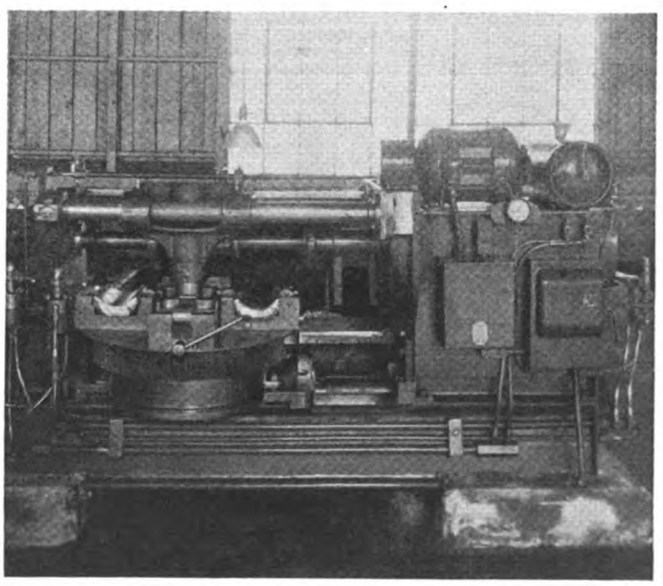
The babbitt bored from the original bearings, and that bored from the bearings after they come from the babbitting mandrels, is thrown from the machine into a lift-truck box and taken to the melting pot, where it is melted under the same conditions as in a babbitting furnace, with an agitating paddle to insure the babbitt being thoroughly mixed. It is then poured from the melting furnace into a rotating pigging form. This form passes, rotating, under the pouring spout of the melting furnace, and by tripping the table, the pigs of babbitt fall into a lift-truck box. Particular attention is paid to the selection of test samples from the pigs after they are run through the pigging furnace, and they are analyzed by a chemist, who determines the necessary additions to be made to this reclaimed metal in order to bring it back to the original specifications when it is again fed to the babbitting furnace.



A modern installation of vats is used to insure that the brasses are thoroughly tinned



The brasses are babbitted on an especially designed air-operated device with a rotating table



Boring machine for preliminary and final boring operations

Pertinent Questions on Hot Boxes

(*Continued from page 23*)

10—Do you employ men in terminal train yards for the sole purpose of servicing journal boxes?

11—Do you service journal boxes at freight houses as provided in A. R. A. Rule 66? If not, what are the objections?

12—What action are you taking toward complying with A. R. A. Rule 66, so far as stored cars are concerned?

13—Do you make special efforts toward servicing foreign cars in accordance with A. R. A. Rule 66, or is it confined to your company's cars?

14—Have you all the facilities required to properly comply with A. R. A. Rule 66?

15—What is your policy in connection with the use of seasonal oil?

16—What action is taken toward removing oil from service which has lost its film strength by overheating?

17—Do you deem the broaching of journal bearings desirable?

18—Do you know of any reason why the method of servicing journal boxes as outlined in A. R. A. Rule 66 is not entirely as it should be?

19—What method is used to ascertain whether or not journal boxes have been packed strictly in accordance with instructions?

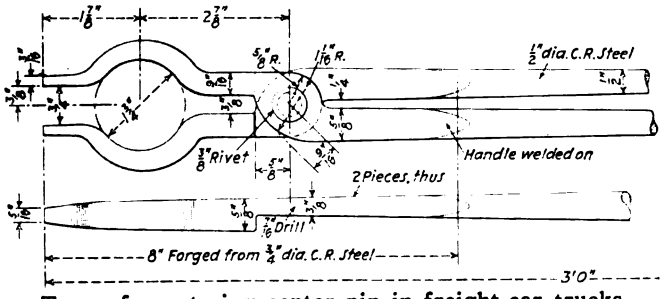
20—What is your general practices to keep packing in original position during cold weather?

21—What is your opinion regarding the time limits specified in A. R. A. Rule 66, for repacking journal boxes?

22—What method is used in determining train delay chargeable to a hot box?

Center-Pin Tongs

A PAIR of special tongs used for raising center pins into a clearance position when trucks are being removed from under freight cars is illustrated. The removal of the truck is thereby effected much more quickly, conveniently and safely than would be possible without



Tongs for entering center pin in freight-car trucks

the use of the tongs or some similar means of raising the center pins.

Referring to the drawing, the construction of the tongs is apparent, the jaws being so designed as to close on a 1¾-in. diameter pin with the open ends of the handles separated 5½ in. The tongs are made of ¾-in. cold rolled steel and the handles drawn out from ½-in. cold rolled steel.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Disputed Bill for Damage by Clam Shell

The Missouri Pacific rendered a bill to the St. Louis-Southwestern covering repairs to certain freight cars during the month of December, 1931, which was rejected because of the fact that items amounting to more than 10 per cent of the entire amount of the bill represented charges which the St. Louis-Southwestern claimed were for repairs from damage done by the McNulty Construction Company in unloading cars by means of clam-shell buckets. The Missouri Pacific disclaimed knowledge of damage by clam shell or other unloading machine and, therefore, denied responsibility for damage to the cars. The St. Louis-Southwestern, on the other hand, took the position that the Missouri Pacific did know that the cars were unloaded in that manner and that the responsibility for the damage rested with the latter road under Rule 32, interpretation 6. The St. Louis-Southwestern contended that the rule and interpretation applied in this case for the reason that the cars involved did not leave the switching district of Pine Bluff and that it was a known fact that these cars were being unloaded by clam shell by the McNulty Construction Company on Missouri Pacific rails, which, it was contended, was sufficient evidence definitely to determine the responsibility of the Missouri Pacific for the damage. It further contended that it is not the intention that handling line employees must actually see each part damaged to establish responsibility for the damage. The Missouri Pacific stated that the cars were delivered to the owners at Pine Bluff and the owners' inspector took exception to certain damage and requested defect cards covering damage by clam shell. The Missouri Pacific inspector, having no knowledge as to where the damage occurred, asked the St. Louis-Southwestern to accept the cars pending investigation as to responsibility. The action of the St. Louis-Southwestern in refusing to accept their own cars, pending investigation, made it necessary for the Missouri Pacific to remove the cars to Little Rock shop for repairs to make the cars acceptable to the owners and to avoid excessive per diem payments. A thorough investigation was conducted to determine how and where the cars were damaged and, according to the statement of the Missouri Pacific, investigation plainly showed that the damage repaired by their forces was not the result of the operation of clam shell or unloading machines.

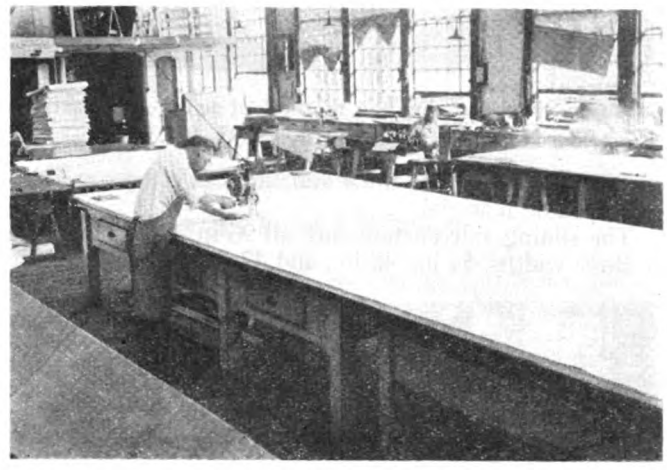
In a decision rendered November 4, 1932, the Arbitration Committee said that: "The Missouri Pacific makes positive statement that its investigation failed to substantiate the car owners' claim that the damage was caused by clam shell while the cars were in the possession of the Missouri Pacific. No conclusive evidence is presented to offset this statement. Therefore, the contention of the car owner is not sustained."—*Case No. 1720, St. Louis-Southwestern vs. Missouri Pacific.*

In the Back Shop and Enginehouse

Making Cab Curtains

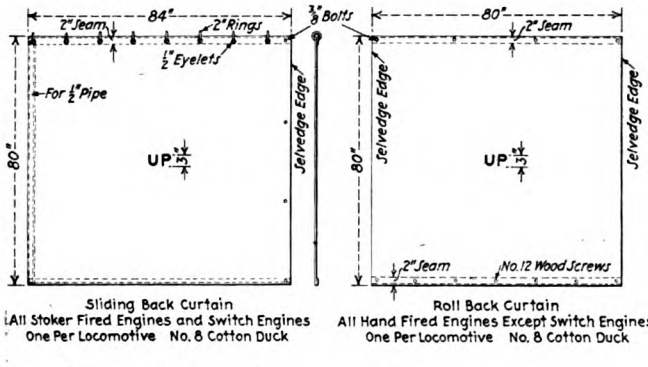
THE question of making locomotive cab curtains for railroads operating in the northern part of the country, and particularly those having substantial numbers of locomotives in operation, is especially important because these curtains must not only provide adequate protection for engine crews, but be designed with these requirements. The actual work of making the curtains is usually performed in the car-department upholstery shop and the magnitude of the job is indicated by the fact that on the Union Pacific, for example, the first order for cab curtains in the fall of 1933 was for a total of 1,800, to be made on store orders in lots of 200 at a time. This work is usually started in August and finished by October, in order that, so far as practicable, all locomotives in service can be equipped before the advent of real cold weather.

A brief outline of how this work is handled on the Union Pacific may be of general interest. The cab curtains used on this locomotive have been standardized in three styles for all classes of locomotives. The hood curtain, made of No. 2 cotton duck, is 88 in. wide by 58 in. or 42 in. long, dependent upon the class of locomotive, being provided with an 18-in. overhang on the tender end and on each side. An inside flap on each is also arranged to fit over the upper end of the side curtains. The hood curtains are stiffened with 1-in. half-round wood strips, either 7 or 11 per curtain, depending upon the length, and have top seams riveted to-



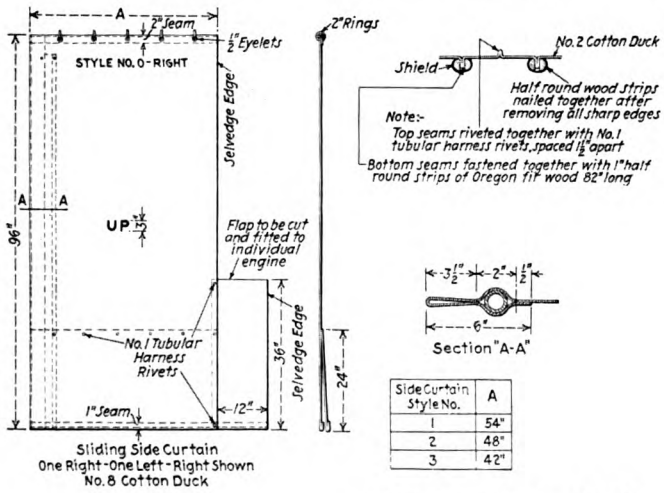
Lay-out table and operation of cutting locomotive and cab curtain material

gether with tubular harness rivets spaced 1½ in. apart. The half-round strips are made of Oregon fir, 82 in. long. The seams are ⅜ in. wide. The overhang is



Sliding Back Curtain
All Stoker Fired Engines and Switch Engines
One Per Locomotive No. 8 Cotton Duck

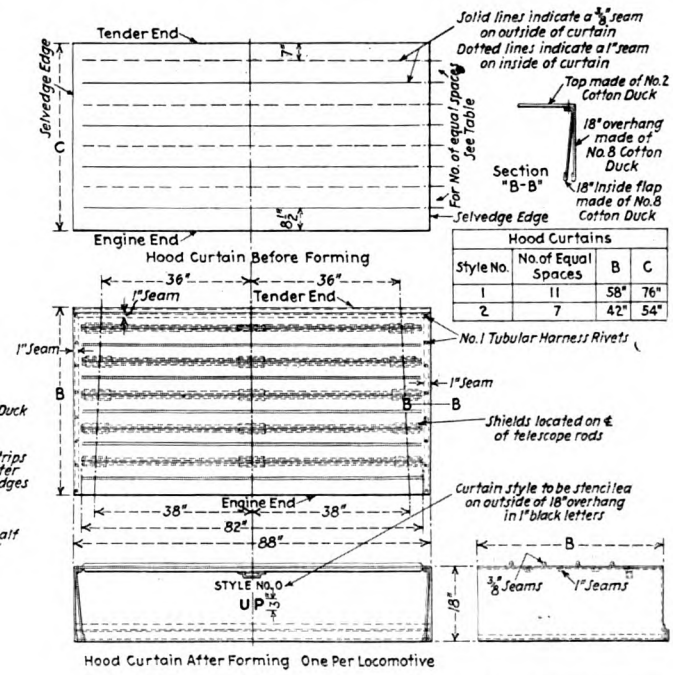
Roll Back Curtain
All Hand Fired Engines Except Switch Engines
One Per Locomotive No. 8 Cotton Duck



Section "A-A"

Side Curtain Style No.	A
1	54"
2	48"
3	42"

Sliding Side Curtain
One Right-One Left-Right Shown
No. 8 Cotton Duck

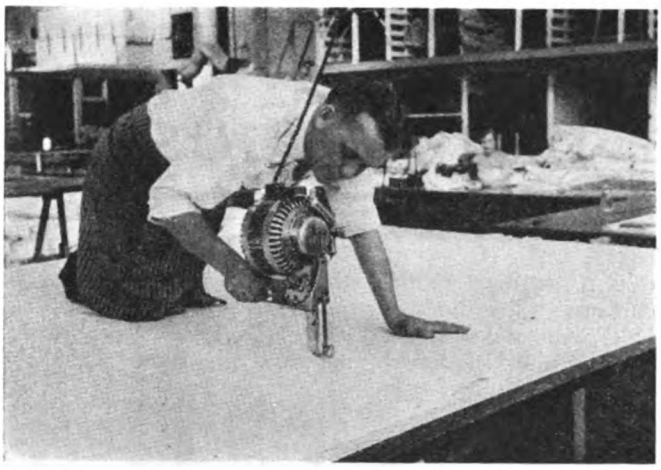


Hood Curtains			
Style No.	No. of Equal Spaces	B	C
1	11	58"	76"
2	7	42"	54"

Hood Curtain After Forming One Per Locomotive

Size of Canvas to be Ordered for the Manufacture of Cab Curtains		
Type of Curtain	Width of Roll	Material
Top of Hood Curtain	88"	No. 2
Sliding Back Curtain	86"	8
Roll Back Curtain	80"	8
Side Curtain-Style-1	60"	8
Side Curtain-Style-2	54"	8
Side Curtain-Style-3	48"	8

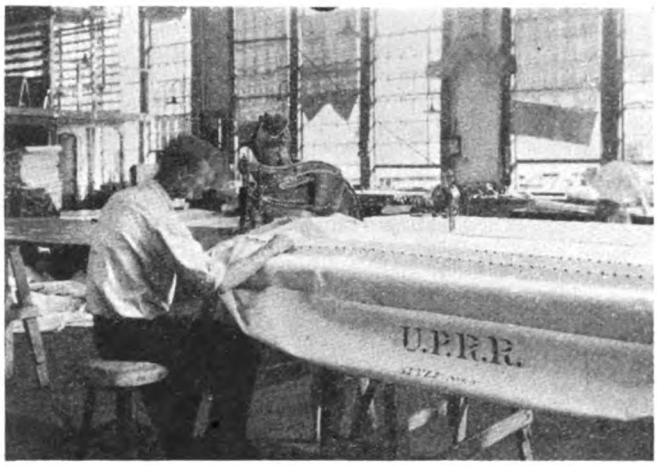
Details of Union Pacific standard cab curtains



Close-up view showing the method of using the Eastman electric goods cutter

made of No. 8 cotton duck and the inside flaps are also of the same material.

The sliding side curtains are all 96 in. high, but made in three widths, 54 in., 48 in., and 42 in., dependent upon



Foot-operated riveting machine used in applying tubular harness rivets

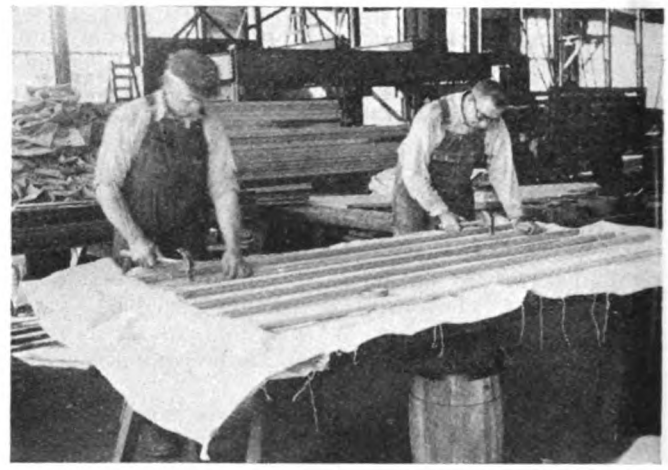
the class of locomotive, the material being No. 8 cotton duck. The top of each side curtain is fitted with ½-in. eyelets and 2-in. rings, which slide on the supporting rod. One side of each side curtain is stiffened with a light 1¼-in. tube, the other selvage being provided with



Curtains after being treated with fire-proofing compound and thoroughly dried

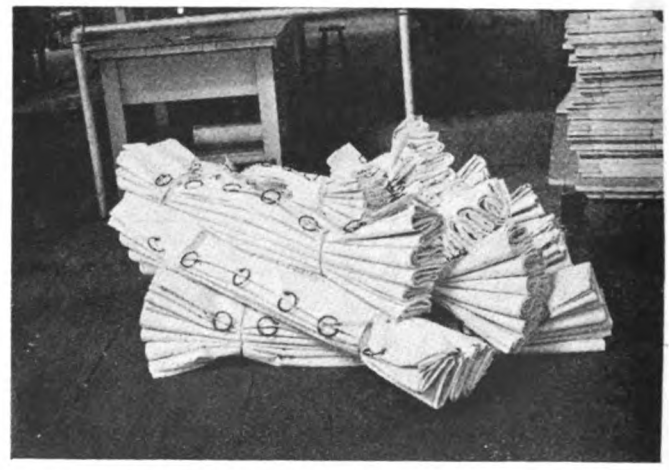
a flap, 36 in. high, to be cut and fitted to the individual locomotive. In general, the back curtains are divided into two types, either the sliding back or the roll back design, the first being used on all stoker-fired locomotives and switch engines, and the latter on all hand-fired locomotives, except switching locomotives. The back curtain, made of No. 8 cotton duck, is 80 in. high, in each case, by 84 in. wide, for the sliding-back type, and 80 in. wide for the roll-back type. Eyelets and 2-in. rings are applied at the top of the sliding-type curtain and a round wood strip, inserted in a 2-in. seam and held by 7 wood screws, in the bottom of the roll-type curtain.

Equipment used at the Omaha (Neb.) shops of the U. P. for manufacturing these curtains is shown in the



Method of applying one-half round 1-in. wood strips to hood curtains

illustration and comprises an electric goods cutter, made by the Eastman Machine Company, Buffalo, N. Y. This machine operates on 110 volts, 60 cycles and 5 amperes, and is designed to cut 50 thicknesses of No. 8 canvas at a time. Five motor-driven Singer sewing machines are



Finished side curtains as stenciled and tied up ready for shipment

provided in this shop, the largest of these machines being used for sewing No. 2 canvas or leather and the other machines for lighter material. A special foot-operated riveting machine is used in applying the No. 1 tubular harness rivets furnished by the Tubular Rivet & Stud Company, Boston, Mass.

A steam-heated, rectangular, sheet-metal tank, set up in an outbuilding, is used for applying the fire-proofing compound, which consists of the following ingredients in 200 gal. of water: 64 lb. of ammonium sulphate, 20

lb. of ammonium carbonate, 24 lb. of boric acid, 14 lb. of borax and 16 lb. of starch. This is adequate to fireproof 50 canopy hoods, the application consisting of soaking the curtains in a boiling vat for one-half hour and then removing the curtains and allowing them to drain and dry.

The detailed operations in making 50 canopy hoods and the time required is as follows:

Cut 50 hoods	1	hr.
Cut 50 short flaps	2½	hr.
Cut 50 long flaps and stencil	4	hr.
Cut 50 six-inch strips for wood strips	1	hr.
Mark 50 hoods for riveting and folding	5	hr.
Hem 50 short flaps	2	hr.
Sew 50 six-inch strips to long flaps	9	hr.
Rivet 50 canopy hoods	37½	hr.
Sew 50 long and short flaps to hoods	8	hr.
Fire-proof 50 canopy hoods	16	hr.
Apply 600 wood strips to 50 hoods	20	hr.
Total	106	hr.

The method of making side and back curtains is much simpler than for hood curtains and consists simply of cutting cotton duck of the specified weight into the correct sizes and hemming the edges, where necessary, for the application of stiffening rods or rolls. The eyelets for sliding curtains are applied, using a hand punch and block with 2-in. rings inserted through the eyelets. All curtains are stencilled with the name of the railroad and the size and type of curtain.

Locomotive Cab Curtains Used, Manufactured, To Be Manufactured and Anticipated Issues for Year 1933

Description	Used up to Sept. 21, 1933	Made up to Sept. 21, 1933	Estimate to be made, balance year 1933	Anticipated issues balance year 1933
Roll back, 80 in. by 80 in.	92	110	50	90
Sliding back, 80 in. by 84 in.	227	350	100	250
Sliding side style, 1 right, 54 in.	127	95	300	300
Sliding side style, 1 left, 54 in.	105	67	300	300
Sliding side style, 2 right, 48 in.	74	70	25	49
Sliding side style, 2 left, 48 in.	77	70	25	44
Sliding side style, 3 right, 42 in.	17	15	65	76
Sliding side style, 3 left, 42 in.	22	10	65	79
Hood style, 1, 58 in.	110	110	200	200
Hood style, 2, 42 in.	86	84	50	50

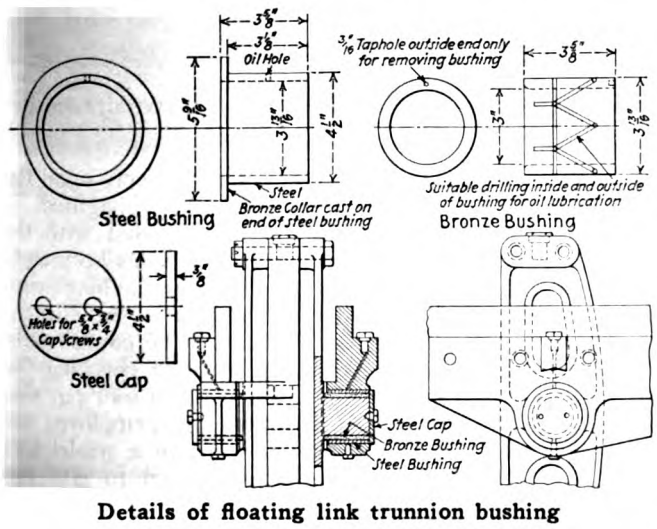
Floating Bushings in Link Trunnions

THE accompanying drawings show the application of a type of floating bushing to the trunnions of a Walschaert link which was developed at the Baltimore shop of the Maryland and Pennsylvania in an effort to eliminate the excessive labor necessary in the replacement of link trunnion bushings on heavy power.

The arrangement consists of a steel bushing pulled tightly into the link support frame and securely anchored. This bushing has a manganese bronze lateral collar on the inside of the frame; the collar being built up on the rough bushing by means of oxy-acetylene welding. A floating bronze bushing which is drilled and grooved for lubrication and a steel collar with cap screws and lock washers complete the assembly.

A few bushings are carried in stock and, with very little labor, the heaviest trunnion bushing, either inside or outside can be renewed in about 15 min.

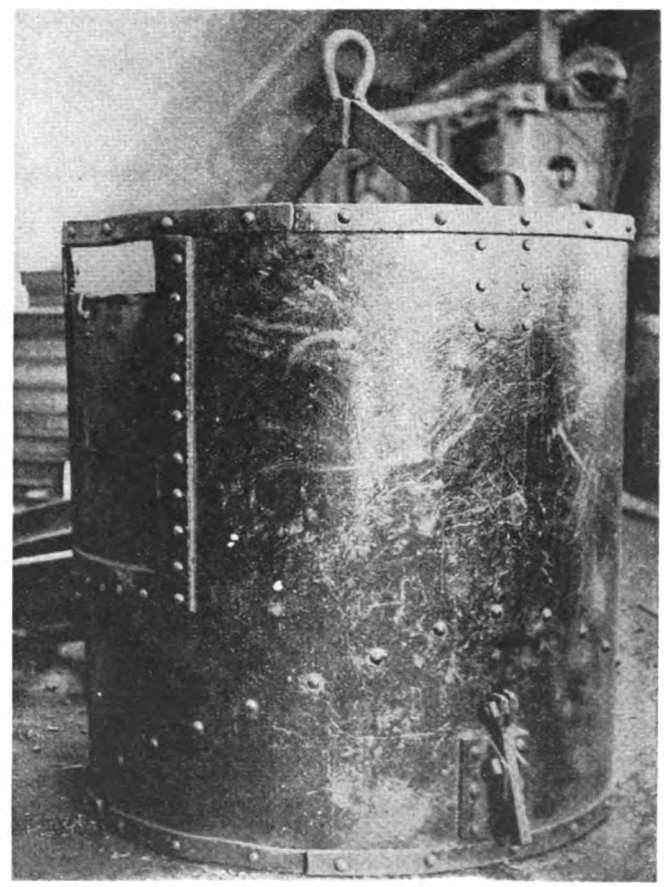
Experience with this arrangement in service has developed the fact that the life of bushings is greatly increased as a result of the equalization of the wear instead of an accumulation of wear in one direction.



Details of floating link trunnion bushing

Boring Container For the Wheel Shop

THE container shown in the accompanying photograph is used in the wheel shop of an eastern railroad for handling borings from the wheel lathe to the scrap car. A pit is provided under the lathe and the borings or turnings fall into a trough that empties into the container. After the container is loaded it is raised from the pit by a crane and taken to the scrap car.



Borings from the wheel shop are carried to scrap bins in this container

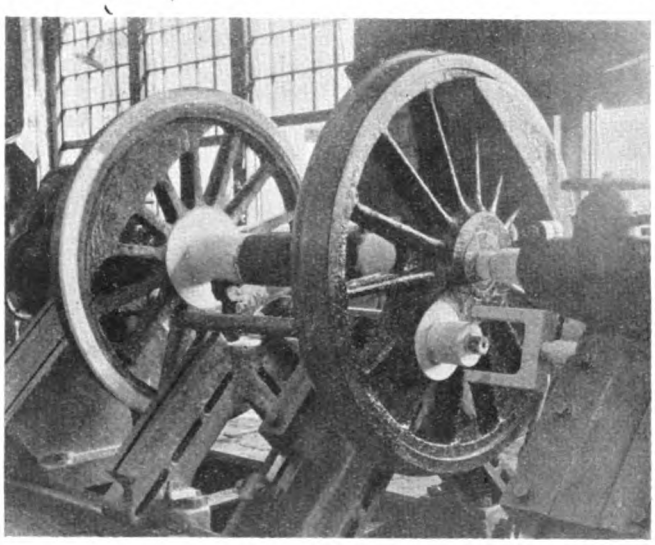
On the right side of the container a "trip" is located which, when engaged on the top angle of the scrap car releases the bottom of the container and permits the con-

tents to fall through. When the container is replaced into the pit at the lathe the bottom automatically closes as it comes in contact with the pit floor.

The container is 48 in. in diameter and is five feet high. It is provided with a drop door on one side in order that it can be used for other purposes around the shop where dirt or other materials can be shoveled into it.

Driving-Wheel Repairs

IN view of the great weights carried on modern locomotive driving wheels and the large amounts of power transmitted through them, they constitute a highly important locomotive detail which must receive the most skillful and conscientious attention in all repair operations. The Union Pacific has made a particular study of driving-wheel maintenance work, and the wheel shop at Omaha, Neb., for example, is organized and equipped to give the driving wheels of locomotives received for repairs

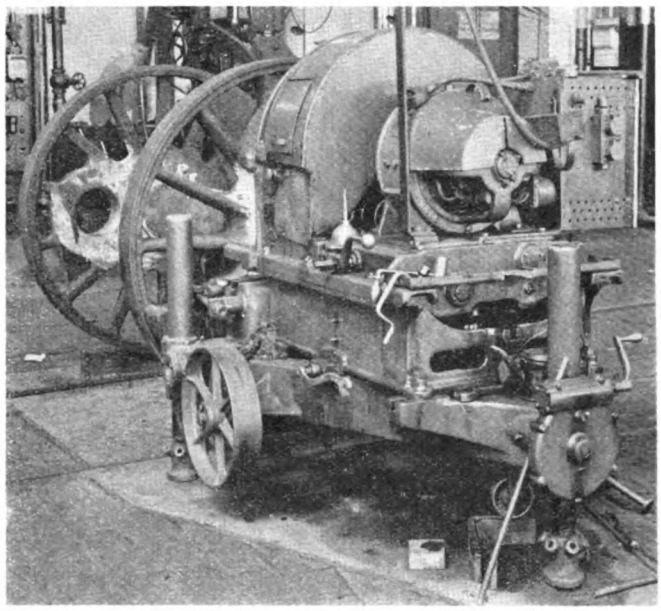


A pair of driving wheels being checked for quarter and stroke in the Niles quartering machine

the kind of attention which is essential for the best results.

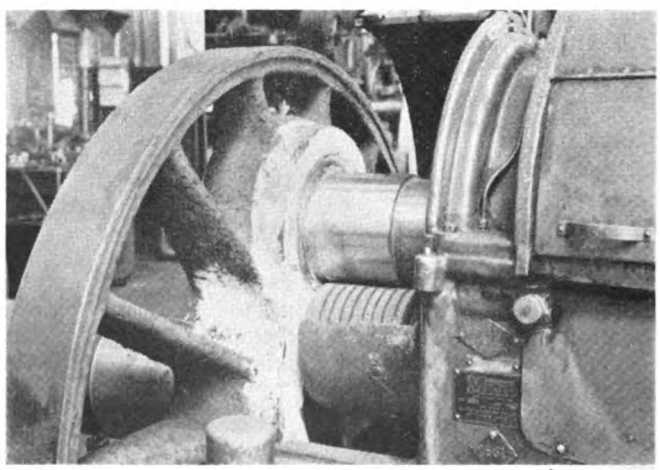
The following general procedure is carried out in reconditioning driving wheels. A competent inspector first inspects the tires of locomotives received at the shop for repairs and, if doubtful, the tires are calipered and checked with an A. R. A. gage to determine if they are thick enough to be turned and still remain above the shop limit of thickness. In case the tires are thin, a new set is ordered so as to avoid any delay in handling the wheels in the shop. In accordance with the more or less general practice, if one tire of a set has a sharp flange, a second-hand tire of the proper thickness is substituted in order to save turning down service metal on the entire set.

After a locomotive is unwheeled in the shop, the driving wheels are moved to the wheel department, and thoroughly cleaned with kerosene, particular attention being paid to the journals, hubs and crank pins. A coating of alcohol and whiting is then applied on these parts and, when dry, a thorough inspection is made to detect any cracks. These are usually found around the keyways, inside of the hubs and between the axle and pin fits. All pins and journals are calipered and any below the shop limit or age limit are dismounted and renewed. In case a new axle is applied to a pair of wheels, both crank pins are accurately checked, machined and ground in order to make sure they are in the correct stroke and quarter, and that this pair of wheels when turned out of the shop will be in condition to give a full term of service without further repairs. In every case, the



Micro portable crank-pin grinding machine set up ready for operation

driving wheels are put in the quartering machine and the pins checked for stroke and quarter, even when they are not removed. Crank pins have been found by this method of checking to be out of position as much as

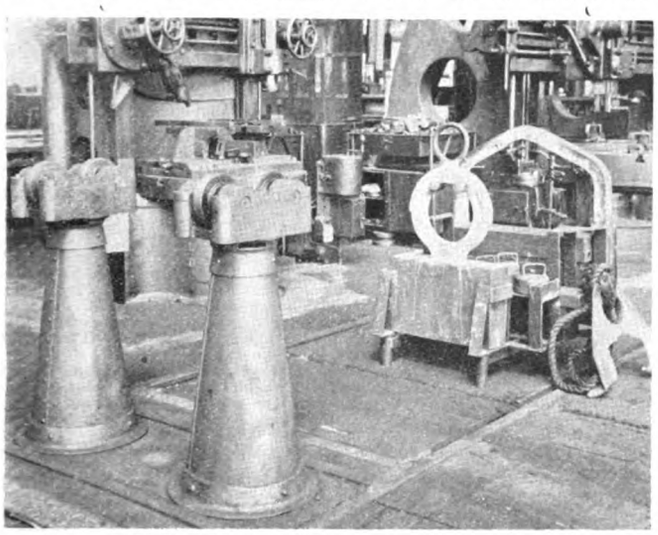


Close-up view of abrasive wheels and a partially-finished crank pin

3/32 in. or even 3/16 and the resultant effects upon the operation of the locomotive can be readily imagined.

The Niles quartering machine is provided with the usual boring bar for finishing crank-pin holes accurately and in the correct location as called for by the blue-print. The machine is also equipped as shown in the illustration with a special box tool, which can be conveniently used in turning the crank pin in place or checking the accuracy of its location. This double-arm tool can also be used for polishing crank pins but is not employed for this purpose at the Omaha shops where a model GG Micro portable crank-pin grinder is used to give the required finish on crank pins. After crank pins are

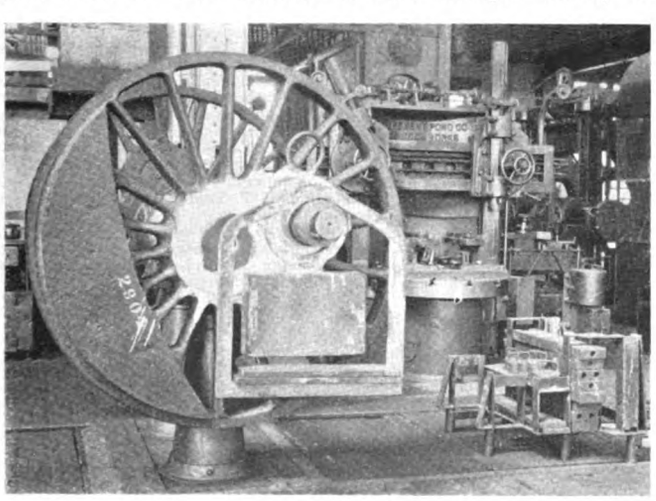
trued in the quartering machine, the driving wheels are taken to the crank-pin grinding machine which is driven by a Fairbanks-Morse 7½-hp. direct-current motor and develops a grinding-spindle speed of 2,400 r.p.m., using grinding wheels 9 in. in diameter, when new. The abrasive wheels not only revolves at high speeds for the grinding operation, but move in a circumference around the crank pin, also having a slow and automatic oscillating



Equipment used in checking locomotive driving-wheel counterbalance at Omaha shops

motion parallel with the axis of the pin, to assure a uniformly smooth and accurate pin diameter. The grinding wheels are kept true and in good cutting condition by the use of a self-contained diamond-truing device provided for in the machine design.

In this grinding operation, both the grinding machine and the driving wheels are supported on a firm foundation and the machine properly located with respect to the wheels and crank pin by means of the supporting jack screws. The machine is then clamped solidly to



A pair of wheels resting on the roller-bearing stands and with weights applied to the crank pin

the wheel, being held square by a bearing against the wheel center, and the grinding operation is carried to completion. The operation, including the set-up time, depends upon the condition of the pin, but usually takes not over 30 min. for an ordinary pin, or 45 min. for a main crank pin.

Method of Counterbalancing

In addition to the great care exercised in assuring the proper axle and crank-pin conditions on Union Pacific locomotive driving wheels, the counter-balance weights are carefully checked on every locomotive going through the shop for general repairs to make sure that they are correct. The equipment, shown in two of the illustrations and used for this purpose, consists of two cone-shape sheet-metal stands, supported on a solid concrete foundation and carrying on the top casting of each a pair of rolls supported on Timken roller bearings, which have been carefully levelled and are designed to bear against the driving wheel journals, permitting the wheels to turn freely. Two types of steel weighted yokes, with roller-bearing supports on the main crank pin, are shown in the illustration. The inner and heaviest yoke is provided with a fixed known weight, as illustrated. The outer yoke, which bears on the outer portion of the crank pin, is designed to carry special bars of different weights, as indicated, with brass tags applied to show the weight of each. With the use of this equipment, an accurate determination can be made of the amount of additional or reduced weight necessary in the counterbalance to make it comply with the blue-print requirements.

Combination Die Head

A COMBINATION die head, hardened and ground throughout, that will take either circular or tangent chasers interchangeably has recently been placed on the market by the Geometric Tool Company, New Haven, Conn., to supplement its present line of die heads. In these die heads the chasers, together with the holders, may be extracted from the head, ground and set and replaced without removing the head from the machine. The chasers may also be removed from the holders and accurately ground in a Geometric fixture which is adapted for use on any universal surface grinding machine. The circular chaser has a series of serrations for coarse adjustment, but any desired degree of adjustment between serrations may also be obtained. The tangent chasers are also provided with equally minute adjustment. In resharpening only metal need be ground off either type of chaser to leave a clean cutting edge. The chaser holder support is made rigid by heavy T-slots and broad reinforcing wings, as well as a post support for the circular chaser which is integral with the holder. The front plates that help form the T-slots which support the chaser holders are removable and replaceable in case of wear. Locking surfaces which hold the chasers in cutting position, a means for positive tripping and adjusting and provision for disassembling the head for cleaning are features of the former design of Geometric die heads that have been retained in these new models. The combination principle (either tangent or circular chasers in one tool) is available in die heads both of the rotary and stationary types, with the helix either in the chaser or in the holder.

WHEN CHICAGO'S CENTURY OF PROGRESS Exposition closed its gates, Fred Metcalf of East Grand Forks, Minn., and G. A. Kingsley of Portland, Ore., both retired engineers on the Northern Pacific, concluded six months of pretty slow going in the cab of a locomotive. These two engineers had charge of the Minnetonka, the first locomotive ever purchased by the Northern Pacific, which was a feature of the show known as "Wings of a Century" at the Fair. Although the Minnetonka was in service every day of the Fair, with the exception of three days when rain prevented the show, it is estimated that it actually traveled only 174 miles during the entire six months.

Among the Clubs and Associations

THE AMERICAN SOCIETY FOR TESTING MATERIALS has moved its headquarters from the Engineers' Club building, 1315 Spruce street, Philadelphia, Pa., to the Atlantic building, 260 South Broad street in the same city.

WESTERN SOCIETY OF ENGINEERS.—High-speed transportation was the subject of discussion at a meeting of the Railroad section of the Western Society of Engineers at Chicago on December 18, A. Cotsworth, Jr., passenger traffic manager, and O. E. Ward, superintendent of motive power of the Chicago, Burlington & Quincy, being the speakers. The changing aspect of passenger traffic, according to Mr. Cotsworth, has necessitated the development of high-speed trains which can be operated at low cost and thus enable the carriers to meet the demands for cheaper transportation. He said that because high-speed trains are designed to accelerate and stop within short distances, they are adapted especially to local business. Mr. Ward described the mechanical features of the train being built by the Burlington and outlined the problems confronted in the development of high-speed trains. He said the designing of a satisfactory braking mechanism for these trains requires special study because of the speed and the light weight of the cars.

Directory

The following list gives names of Secretaries, dates of next regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 2205, 150 Broadway, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—Division V. —MECHANICAL.—V. R. Hawthorn, 59 East Van Buren street, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorn, Chicago.

DIVISION VI.—PURCHASE AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Columet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. —Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, Room 332, 30 Church street, New York.

MACHINE SHOP PRACTICE DIVISION.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—Edgar J. Kates, 1350 Broadway, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago Regular meetings, second Monday in each month except June, July and August, La Salle Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth street, Council Bluffs, Iowa. Regular meetings, second Tuesday of each month at Council Bluffs.

CENTRAL RAILWAY CLUB OF BUFFALO.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month except June, July and August, at Hotel Statler, Buffalo.

CLEVELAND RAILWAY CLUB.—F. B. Frericks, 14416 Alder avenue, Cleveland, Ohio. Meeting second Monday each month, except June, July and August, at the Auditorium Hotel, East Sixth and St. Clair avenue, Cleveland.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon, 12:15 p. m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha street, Winona, Minn.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN. —C. L. Roberts, R. F. D. 5, Peoria, Ill.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md. Annual meeting October 17-18, Hotel Stevens, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION. —J. D. Conway, 1841 Oliver buiding, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

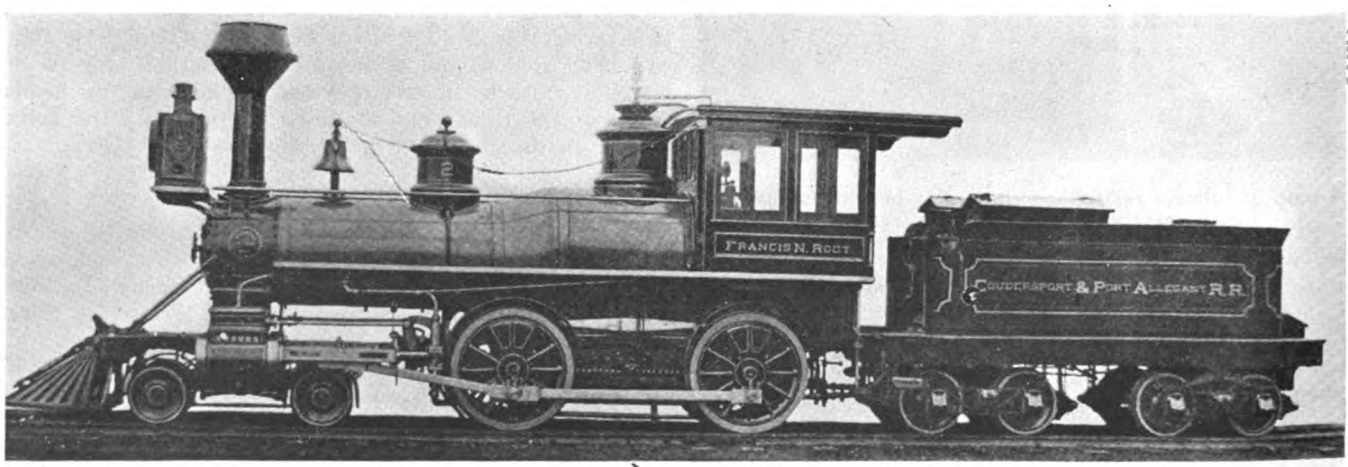
SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TORONTO RAILWAY CLUB.—N. A. Walford, district supervisor car service, Canadian National, Toronto, Ont. Meetings first Friday of each month except June, July and August.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—C. L. Emerson, 822 Straus Building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

* * *



The Francis N. Root—No. 2 of the Coudersport & Port Alleghany Railroad—Built in 1882—Cylinders, 12 in. by 16 in.; driving wheels, 43 in. diameter

NEWS



THE AMERICAN TANK LINE has accepted delivery of 10 tank cars of 40 tons' capacity. These cars were ordered from the American Car & Foundry Company.

THE PENNSYLVANIA SALT MANUFACTURING COMPANY has ordered two tank cars of 40 tons' capacity from the American Car & Foundry Company.

THE CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC is inquiring for 50 coaches and will shortly inquire for 25 baggage cars.

THE NATIONAL RAILWAYS OF MEXICO has placed an order with the Locomotive Firebox Company for nine sets of syphons to be applied to existing Consolidated, Pacific and Mikado-type locomotives.

THE ESCANABA & LAKE SUPERIOR has purchased from Fairbanks Morse and Company a pneumatic-tired rail bus for use in transporting mail and passengers over its line. The bus, which was built to E. & L. S. specifications, consists of a Dodge chassis, equipped with Goodyear Tire & Rubber Company pneumatic rail tires.

Burlington High-Speed Train To Be Ready in March

THE THREE-CAR articulated, high-speed train being built by the E. G. Budd Manufacturing Company for the Chicago, Burlington & Quincy will be delivered to the railroad in Chicago during March, after a three weeks' tour of the East. While the itinerary of the train has not been definitely decided upon, approximately 24 eastern points and 80 western points will be visited before the train is placed in regular service.

Eastman Gives Results of Special Inspection of Stored Equipment

CO-ORDINATOR EASTMAN on January 4 announced the results of the special inspection of cars and locomotives, reported stored in serviceable condition October 1, made at his request by I. C. C. bureaus saying that facts developed lead to the conclusion that neither fears of a freight car shortage nor the optimism of those who relied upon railroad reports of surplus equipment were fully justified. Of freight cars inspected 55.5 per cent were found fit for the service for which they were designed, 4.4 per cent unfit for any service until repaired and 40.1 per cent were suitable for the transportation of certain commodities only. Of locomotives inspected 21.3 per cent were in need of repairs requiring three days or more.

Railway Car Building Industry Code Hearing

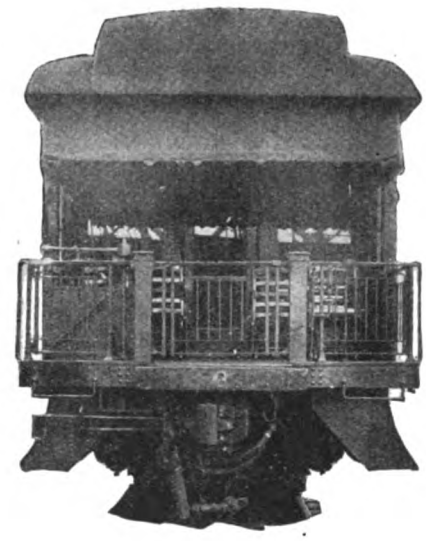
TOTAL SALES of the railway car building industry during the first half of this year were but slightly more than 3 per cent of an estimated capital investment of $270,000,000, proponents of a code of fair competition for that industry told the National Recovery Administration at the public hearing conducted before Assistant Deputy Administrator F. H. Kuhn, at Washington on December 27.

C. A. Liddle, president of the Pullman Car & Manufacturing Corporation, formally presented the code and stated that it had received written approval of each of the 20 members of the American Railway Car Institute, representing 96 per cent of the industry's volume of sales. After pointing out that total business had dropped from a value of $258,926,973 in 1929 to $7,523,000 in the first six months of 1933, with a consequent decrease in employment from 34,243 persons to 5,920 workers, Mr. Liddle asserted that it was "extremely doubtful" wherther the slight interest now observable in new purchases of the industry's products would continue if production costs were increased beyond the point proposed in the code.

Speaking of labor provisions of the code, F. A. Stevenson, also representing the institute, declared that the proposed 40-hour maximum week would operate to increase employment 20 per cent. He stated that the previous "customary" workweek ranged from 50 to 55 hours, and cited this fact in support of the request for a 48-hour maximum week during any 12 weeks in a year to take care of "spasmodic" peak periods.

Objections were made as to what were characterized as "qualifications" of the proposed basic minimum wage of 40 cents per hour; the proposal to have all bids deposited in advance with the code authority and to the provision which would limit productive capacity of the industry; the method for depositing bids with the code authority, and the inclusion of an actual cost formula in the code.

After announcing that the code committee would meet with various representatives of the N.R.A. in a series of conferences to develop a generally satisfactory code for presentation to the President, the hearing was indefinitely recessed.



Use of Air-Conditioned Equipment Extended

ALL THROUGH passenger trains on the Pennsylvania will be air-conditioned next summer according to an announcement made recently by D. M. Sheaffer, chief of passenger transportation. Last summer for the first time all of the hourly trains between New York and Philadelphia on the Pennsylvania, as well as its through trains between New York, Philadelphia and Washington, carried air-conditioned coaches, dining cars and parlor cars. Their use will be extended to the main-line service for all through trains between the principal cities of the East and West. The Pennsylvania at the present time, the announcement says, has in operation the largest fleet of air-conditioned trains of any railroad in the world. The additional coaches, diners, and Pullman parlor and sleeping cars which will be placed in service between now and next May in its through East and West trains will raise the total number of air-conditioned cars to almost 700.

An order has been placed with the Frigidaire Corporation, amounting to $500,000 for the material necessary to air-condition these coaches and dining cars on these trains. The equipment, consisting of coils, condensers, etc., will be turned over to the Pennsylvania as soon as it is ready, and the installation will be made in the Altoona shops of the railroad.

The New York Central plans a complete air-conditioning of the Twentieth Century Limited and also will air-condition cars in its principal trains between the chief commercial centers which they serve. Sleeping cars, dining cars, club cars and some coaches will be equipped. Dining cars on the Century already are air-conditioned. The work of installing the new equipment is expected to be completed and the cars ready for service next summer. Since July, 1932, this road has air-cooled cars on its principal trains serving not only New York and Chicago, but in the other leading cities on its lines. The Central now owns about 200 units of air-cooling equipment which will be retained to cool cars on trains that do not have the new air-conditioning apparatus.

P. W. A. Negotiations

AS THE NEGOTIATIONS and "paper work" incident to the making of loans to railroads by the Public Works Administration gradually progress it becomes apparent that a very considerable volume of employment and business is to result from the willingness of many roads to anticipate future requirements and the willingness of the government to finance them on as reasonable terms as the law will permit. Allotments for railroad loans, to be used for the purchase of new equipment, rails, fastenings, etc., the improvement of roadway, bridges, etc., or the repair or modernization of existing equipment and facilities, now total approximately $200,000,000. Applications for loans from the P. W. A., or allotments have already been made as follows:

	Applied for	Allotted
Baltimore & Ohio	.....	$4,230,000
Boston & Maine	.....	5,500,000
Central of Georgia	.....	500,000
Chesapeake & Ohio	.....	18,290,000
Chicago & Eastern Illinois	$251,300	.....
Chicago & North Western	3,500,000	1,400,000
Chicago, Milwaukee, St. Paul & Pacific	1,818,750	.....
Erie	.....	11,964,000
Illinois Central	10,000,000	9,300,000
Interstate Railroad	.....	250,000
Kansas, Oklahoma & Gulf	.....	265,000
Lehigh & New England	.....	1,500,000
Lehigh Valley	.....	2,000,000
New York, Chicago & St. Louis	.....	5,028,500
New York, New Haven & Hartford	4,850,000	3,500,000
Northern Pacific	.....	1,252,000
Pennsylvania	84,000,000	77,000,000
Pittsburgh & West Virginia	47,000	.....
Southern Pacific	.....	12,000,000
Wabash	1,489,803	1,489,000
Waco, Beaumont, Trinity & Saline	5,000,000	.....

Inquiries or orders for new equipment, the building in company shops or purchasing of which will be financed with the money allotted by the P. W. A., have been placed as follows:

	Locomotives	Freight cars	Passenger cars
B. & O.	..	820 coal	..
C. of Ga.	..	200 coal	..
C. & O.	..	4,500 hopper 2,500 gond.	15 coaches 11 bag. & mail
Erie	..	800 box 125 flat 100 furn. 500 auto. 2,500 hopper 500 box	125 coaches 8 bag. & mail
L. & N. E.	..	500	
N. Y. C. & St. L.	15 freight 5 switchers	500 box 500 gond.	7 coaches 1 bag. & mail
	20 tenders	175 stock 25 flat	
Nor. Pac.	10 pass.*	...	..
Penn.	100 elect†	7,000†	..

* Order placed with the Baldwin Locomotive Works.

† The freight cars and a number of the locomotives will be assembled in the company's own shops.

Programs for the repair or improvement of equipment are being developed as follows:

Baltimore & Ohio.—Repairs to 5,000 freight cars and 240 locomotives.

Boston & Maine.—Reconditioning locomotives, freight cars and passenger cars.

Illinois Central.—Repairs to 16,015 freight and 228 passenger cars.

Interstate Railroad.—Rebuilding 500 coal cars.

Lehigh Valley.—Heavy repairs to 1,000 coal cars, rebuilding 1,000 box cars, and classified repairs to 60 locomotives.

New York, New Haven & Hartford.—Air conditioning 142 steel passenger cars assigned to through service between New York and Boston and New York and Springfield; repairing and painting 210 multiple-unit coaches; general overhauling and reconditioning of 900 cars which have reached an average age of 15 years, including the renewal of roof and side sheets for 139 of them and general repairs and certain minor improvements to the 142 cars to be air conditioned. Painting and heavy repairs for 95 all-steel cars of the New York, Westchester & Boston.

Southern Pacific.—Reconditioning locomotives and cars.

Wabash.—Repairs and modernization of 1,500 cars.

Settle Shopmen's Wage Dispute in Canada

A COMPROMISE has been reached in the wage dispute between the Canadian shop crafts employees, numbering some 35,000, and the Canadian railways. Both parties have agreed to a 15 per cent reduction from basic wages for one year, dating from December 16, thus bringing these employees' conditions in line with clerical and operating department employees who likewise have accepted a 15 per cent reduction for a year.

Employees whose bulletined working time is less than 40 hours per week will have only a 10 per cent reduction. At the end of one year the reduction will drop to 10 per cent for those workers who now take the 15 per cent. After October 16, 1934, either party may serve 30 days' notice of a desire to change the percentage for the year following. Both parties expressed themselves as pleased at having been able to reach common ground.

Hearing on Manufacturers' N. R. A. Codes

A PUBLIC hearing on the codes submitted to the National Recovery Administration by several branches of the railway equipment and appliance industry was held before Deputy Administrator H. O. King at Washington on December 21 in connection with approximately forty separate codes representing industries affiliated with the Machinery and Allied Products Institute, which had been formed to advise member industries on code matters with a view to the establishment of uniform employment conditions. The proposed codes, which had already been the subject of numerous conferences and revisions for the purpose of bringing them into accord with the general policies established by the N.R.A., include practically uniform conditions as to wages, hours, and other labor provisions, but differ somewhat in the trade practice and administrative sections and leave full autonomy with each trade association concerned in while providing for separate code authorities for each industry. At the outset of the hearing J. W. O'Leary, president of the Machinery and Allied Products Institute, asked that the references to that organization in the various codes be deleted but he submitted in tentative form a proposal for provision for a consolidated code authority in addition to the ones separately provided for.

The proposed codes of special interest to the railroads are those of the Locomotive Institute, the membership of which is composed of builders of locomotives of more than 1,200 hp. per locomotive; the Associated Builders of Small Locomotives, builders of locomotives of 600 hp. or less, and parts thereof; the Railway Appliance Manufacturers' Association, manufacturers of railway hand cars, push cars, velocipede cars, motor cars and special appliances thereof, locomotive water cranes and parts thereof; the Railway and Industrial Spring Association, producers and sellers within the United States of hot-formed helical, elliptical and special springs, and/or pressed steel journal box lids and/or pressed steel spring plates; the Steel Tire Association, and the Diesel Engine Manufacturing Industry.

The codes provide for a maximum work week of 40 hours but with provision for 48 hours in peak periods and under special conditions, with a minimum wage rate of 40 cents an hour except where the rate was lower on July 1, 1929, in which event the minimum may be as low as 35 cents. In general they provide for an initial period of 120 days after which they might be terminated by a vote of two-thirds of the employers assenting to a particular code.

A representative of the Division of Economic Research and Planning of the N.R.A. asked each industry to file statistics regarding their payrolls, products, and wages, showing the number employed at the minimum and the seasonal fluctuations in production and employment.

Results of Mechanical Division 1933 Letter Ballot

AT THE SESSION of the American Railway Association, Mechanical Division, held in Chicago, June 27, 1933, the recommendations from various committees were ordered submitted to a letter ballot of the members. These recommendations, totaling 51 in number, to amend the standard and recommended practice of the division, have just been formerly approved, effective March 1, 1934.

The detailed results of the letter ballot are covered in Mechanical Division circular No. D.V.-810, which shows favorable action regarding recommendations of the various committees, as follows:

Brakes and Brake Equipment.—(1) On the proposition to permit the use of the wing-type emergency valve and piston, and the short-stem-type emergency valve.

(2) On the proposition to adopt as standard the requirement that A. R. A. standard triple-valve test racks must be equipped with a device for locating the feed groove, as recommended by the committee.

(3) On the proposition to adopt as standard the No. 15 brake beam, including compression member, tension member, head, strut, shoe key and assembly, and the substitution of head, strut and assembly for those now shown in the Manual.

Car Construction.—(4) On the proposition to adopt as recommended practice, designating letters and definition for box cars equipped with permanent automobile stowing equipment.

(5) On the proposition to adopt as recommended practice, designating letters and definition for electric passenger trailers.

Couplers and Draft Gears.—(6) On the proposition to substitute knuckle nose wear and stretch limit gage No. 24992-A for gage No. 24992. (Note: In the stretch limit portion of Gage 24992-A, as shown on page 27 of Circular D.V.-807, the $11^{9}/_{16}$-in. dimension should be corrected to $11^{10}/_{16}$ and the $1^{1}/_{16}$-in. dimension should be corrected to $1^{11}/_{16}$. The gage should also have the letter "A" stenciled on it in addition to the number to designate the latest type gage.)

(7) On the proposition to adopt as standard, the revised coupler contour shown in Fig. 3, pages 29-56, to be designated as A. R. A. Standard No. 10-A contour.

(8) On the proposition to adopt as standard the relocation of the knuckle-pivot-pin hole and the addition to the pulling surface of the pin protectors of standard Type-E couplers.

(9) On the proposition to approve as standard, the change in radii of pulling lugs and pin protectors for standard Type-E couplers.

(10) On the proposition to approve as standard, the changes to A. R. A. standard Type-E coupler gages.

(11) On the proposition to authorize the coupler manufacturers to scrap their patterns, core boxes and gages covering the Type-D coupler bodies.

Loading Rules.—(12) On the proposition to show Interchange Rule 36 in the revised Loading Rules in condensed form.

(13) On the proposition to add paragraph to the General Rules.

(14) On the proposition to add paragraphs to Loading Rule 1, Sec. L, Par. 2.

(15) On the proposition to revise Fig. 23, Rule 132.

(16) On the proposition to revise Fig. 44-E, Rule 201-A.

(17) On the proposition to revise Loading Rule 220.

(18) On the proposition to adopt proposed Fig. 60-A in place of Fig. 58, 59 and 60, Rule 223.

(19) On the proposition to revise Loading Rule 230 and eliminate Sketch A.

(20) On the proposition to revise Loading Rule 240-B.

(21) On the proposition to adopt revised figures for the loading of cast-iron pipe, Rule 252.

(22) On the proposition to revise Loading Rule 261.

(23) On the proposition to reduce the size of stakes.

(24) On the proposition to revise the requirements for cleats underneath car floors.

(25) On the proposition to adopt the methods proposed by the Committee for the loading of steel-wire mesh and bar mats.

(26) On the proposition to revise Loading Rule 302 and Fig. 99, 100 and 101, and adopt new Fig. 101-A-1.

(27) On the proposition to revise Loading Rule 302-A.

(28) On the proposition to adopt Fig. 101-H and 101-I covering the loading of heating and locomotive-type boilers.

(29) On the proposition to revise Rule 306 and Fig. 103-A and 103-C.

(30) On the proposition to adopt new Fig. A, B and C covering the loading of four-wheel auto trailers, composite freight containers and all-metal freight containers.

(31) On the proposition to revise Loading Rule 405 and Fig. 112-C and eliminate Fig. 112-B.

(32) On the proposition to revise Loading Rule 414 and Fig. 111.

Locomotive Construction.—(33) On the proposition to adopt as recommended practice, reducing tees, air pump union studs, reducer couplings and caps, and straight pipe couplings.

(34) On the proposition to revise Page 8, Sec. F. of the Manual, covering shrinkage allowances for locomotive tires.

(35) On the proposition to adopt as recommended practice that convex die blocks be used in clamping bands in hydraulic press, as shown by Fig. 3, or its equivalent.

(36) On the proposition to adopt as recommended practice that nibs be applied to the two outer top and bottom leaves alongside of the band and in the center, as per Fig. 4, or in the center with band depression looking into the nib.

(37) On the proposition to adopt recommended practice for checks, flanges, stud-circle diameters and reinforced plates for injectors.

Lubrication.—(38) On the proposition to add to the recommended practice for new car oil, a specification for all-year-service car oil.

(39) On the proposition to revise the specifications for dust guards.

Specifications for Materials.—(40) On the proposition to replace the present standard specifications for carbon-steel bars for railway springs with recommended-practice specifications.

(41) On the proposition to revise the recommended-practice specifications for carbon-steel castings.

(42) On the proposition to revise the recommended-practice specifications for air, gas and oxygen hose.

(43) On the proposition to revise the recommended-practice specification for chain.

(44) On the proposition to revise the recommended-practice specification for elliptic springs.

(45) On the proposition to withdraw from the Manual all of the specifications for paints and paint materials.

(46) On the proposition to withdraw from the Manual the present recommended-practice specifications for lumber and replace them with the revised specification recommended by the Committee.

Tank Cars.—(47) On the proposition to revise standard drawings of A. R. A. fundamental dome ring and cover.

(48) On the proposition to adopt as recommended-practice, dome covers for ICC-104-A and ICC-105-A tank cars.

Wheels.—(49) On the proposition to revise the recommended-practice specifications for cast-iron wheels.

(50) On the proposition to revise the recommended-practice symbols for marking defective cast-iron, cast-steel, wrought-steel and steel-tired wheels.

General Committee.—(51) On the proposition to adopt alternate location for retaining valve on box and other house cars.

Dean Potter Added to Committee on Railway Research

DEAN A. A. POTTER of Purdue University has been added to the Committee on Railway Research of the Science Advisory Board, according to an announcement by Dr. Karl T. Compton, chairman of the board.

Dean Potter is president of the American Society of Mechanical Engineers and an authority on steam engineering at Purdue University, whose laboratories have long been famous for their co-operation with railroads and railroad equipment companies in engineering research and tests. This committee, chosen from among the leading directors of industrial research in the country, was formed at the request of Joseph B. Eastman, federal co-ordinator of transportation, to co-operate with a corresponding committee of railroad executives.

"This co-operation," said Dr. Karl T. Compton, "should go far toward convincing the public that the railroads are making a determined effort to improve their service to the public and to strengthen their financial position by taking maximum advantage of modern technology. To bring this about, these leaders of industrial research have agreed, without compensation and for the public good, to co-operate with the railroad executives in an effort to map out the best plan that their joint knowledge and experience can devise, and to assist in putting this plan into operation. Contrary to certain reports, there is no suggestion or probability of forcing on the railroads a huge central research laboratory."

According to Dr. Compton, the probable approach of these joint committees will be a survey of the research facilities and procedures now existing in the railroad and equipment companies and a comparison of these with the similar bases of research in outstandingly successful industries. The object will be to determine whether the principles of scientific research are being applied in the railroad industry as thoroughly and effectively as is reasonably practicable, and, if not, how this situation can best be corrected. The survey will not be shaped or guided by preconceived ideas, and will be carried on with full realization that the conclusions reached must fit the peculiar conditions of the industry.

Supply Trade Notes

JOSEPH T. RYERSON & SON, INC., Chicago, has commenced work on an extensive addition to its St. Louis, Mo., steel service plant.

B. T. THOMPSON, general sales agent of the Standard Oil Company of Indiana, with headquarters at Chicago, retired on December 30.

THE INDEPENDENT PNEUMATIC TOOL COMPANY has moved its New York sales office from 1463 Broadway to 330 West Forty-second street, New York City.

JOSEPH T. RYERSON & SON, INC., of Boston, New York and Chicago has purchased the stock and good will of Bacon & Co., iron and steel company of Boston, Mass.

THE PITTSBURGH PLATE GLASS COMPANY, Pittsburgh, Pa., is building an addition to its Duplate plant at Creighton, Pa. The addition will consist of a three-story wing of steel, concrete and brick construction.

D. J. ALMON, Paul Brown building, St. Louis, Mo., has been appointed district sales agent for Morrison Metalweld Process, Inc., Buffalo, N. Y. Mr. Almon will represent this company in the Southwest territory.

E. A. TOLLEY, since February, 1933, assistant manager and prior to that salesman in the San Francisco (Cal.) branch of the Garlock Packing Company, Palmyra, N. Y., has been appointed district manager of that branch, succeeding C. D. Allen, deceased.

JOSEPH MCNALLY, formerly connected with the General American Tank Car Corporation, Chicago, has been appointed sales engineer of Iron & Steel Products, Inc.

B. R. WETHERBY, 404 Donovan building, Detroit, Mich., has been appointed Michigan representative of Huron washout plugs and other railroad and industrial specialties manufactured by the Huron Manufacturing Company, Detroit. Mr. Wetherby will handle also certain roads in the Ohio district.

H. Ross POULSON has been appointed sales engineer in the Transportation and Government department of the Johns-Manville Sales Corporation, with headquarters at Chicago. Mr. Poulson was formerly associated with Johns-Manville, and during a brief interruption in his employment was associated with the American Hair & Felt Company.

MYRON C. TAYLOR, chairman of the United States Steel Corporation, announces that Edward R. Stettinius, Jr., has been selected by the Finance committee for the position of vice-chairman of the Finance committee of the corporation, effective April 1, 1934, and succeeding to the vacancy arising from the promotion of William J. Filbert to the chairmanship. Mr. Stettinius is at present vice-president of General Motors Corporation.

F. R. FAULK, 50 Penn avenue, Pittsburgh, Pa., has been appointed district sales representative of the Universal Power Corporation, Cleveland, Ohio, and the Welding Equipment & Supply Company, 2720 East Grand boulevard, Detroit, Mich., has been appointed Detroit distributor for the same corporation.

PHILIP C. KEMP, formerly a member of the law firm of Simpson, Thacher & Bartlett, New York, and more recently a deputy administrator of the N.R.A., has been appointed vice-president and general counsel of the American Locomotive Company.

MYRON C. TAYLOR, has retired as chairman of the Finance Committee of the United States Steel Corporation, but will continue his other offices as chairman of the board of directors and chief executive officer. William J. Filbert succeeds Mr. Taylor as chairman of the Finance Committee.

W. A. NUGENT has been appointed sales manager of the Independent Pneumatic Tool Company, Chicago. Mr. Nugent, formerly district manager of the Chicago territory, has been with the company 19 years and during this period has served as St. Louis, Mo., branch manager, as assistant to the president and in other similar capacities. He assumed his new duties on December 1 and was placed in active charge of all pneumatic and electric tool sales.

B. C. HOOPER, formerly sales manager of the Industrial Truck division of the Baker-Raulang Company, Cleveland, Ohio, has been placed in charge of this company's Chicago sales office. For many years Mr. Hooper acted as dealer for the Baker-Raulang Company in St. Paul, Minn.; he was then transferred to the Cleveland factory as special railroad representative, and in 1929 was made sales manager. W. F. Hebard, formerly of the W. F. Hebard Company, who represented the Baker-Raulang Company for many years in Chicago, is associated with Mr. Hooper and will continue to handle their railroad activities.

C. W. BENNETT on January 1 became president of the American Sheet & Tin Plate Company, with headquarters at Pittsburgh, Pa. Mr. Bennett has been connected with the steel industry since 1892. He has been with the American Sheet & Tin Plate Company, or properties absorbed by it, since 1897, serving in various capacities and was acting president of that company since January 1, 1933. Eugene W. Pargny, whom Mr. Bennett succeeds as president of the American Sheet & Tin Plate Company, has served as president of that company since 1909. Mr. Pargny entered the employ of the Apollo Iron & Steel Company in 1890 continuing with that company and its successor, the American Sheet & Tin Plate Company, in various official capacities. In 1904 he served as second vice-president and in 1906, was elected first vice-president, becoming president in January, 1909. Mr. Pargny at his own request has been relieved of his duties and retired under the pension plan of the United States Steel Corporation, of which the American Sheet & Tin Plate Company is a subsidiary.

HARRY W. MCQUAID and HAROLD T. BLAIR have joined the metallurgical staff of the Republic Steel Corporation, Youngstown, Ohio; Howard W. Burkett has been transferred from Youngstown to the post of metallurgical engineer in the Buffalo district, and Elmer Larned has been appointed metallurgical engineer in the Chicago district. Mr. McQuaid will devote his time to research and development work, and Mr. Blair will specialize in tin-plate products.

F. W. WATERMAN, president of the National Tube Company, a subsidiary of the United States Steel Corporation, retired under the pension plan of the corporation on January 1. Except for a brief period when he was connected with the Canadian steel companies, Mr. Waterman has been in the service of various companies now



Benjamin F. Harris

affiliated with the United States Steel Corporation in sundry capacities, serving since January, 1920, as president of the National Tube Company. Benjamin F. Harris, president of the Oil Well Supply Company, one of the subsidiary companies, succeeds Mr. Waterman as president of the National Tube Company. Mr. Harris, who will continue also as president of the Oil Well Supply Company, first became connected with the steel industry when he entered the service of the American Sheet & Tin Plate Company in 1903.

A. L. HUMPHREY has been elected chairman of the board of the Westinghouse Air Brake Company, to succeed the late H. H. Westinghouse. At the time of his election Mr. Humphrey was executive director, and prior to that time had been president for 14 years. His latest achievement is significant for two reasons: It marks the culmination of 30 years' service with the company, and it is the first time during the company's history that anyone outside of the immediate Westinghouse family has been so honored. Mr. Humphrey was born at Buffalo, N. Y., but later moved to a rural community in the middle west. He received his early education at the country schools of Maquoketa, Iowa, and Plattsmouth, Neb., and worked on the farm. Following this, he obtained a position as a drug clerk and thereupon determined to study pharmacy. Circumstances intervened, however, as a local physician, then chief surgeon for the Burlington & Missouri River (now part of the C. B. & Q.), recognizing a mechanical trend in the youth's mind, persuaded Mr. Humphrey in 1877 to accept a position as machinist apprentice with what is now known as the Chicago, Burlington &

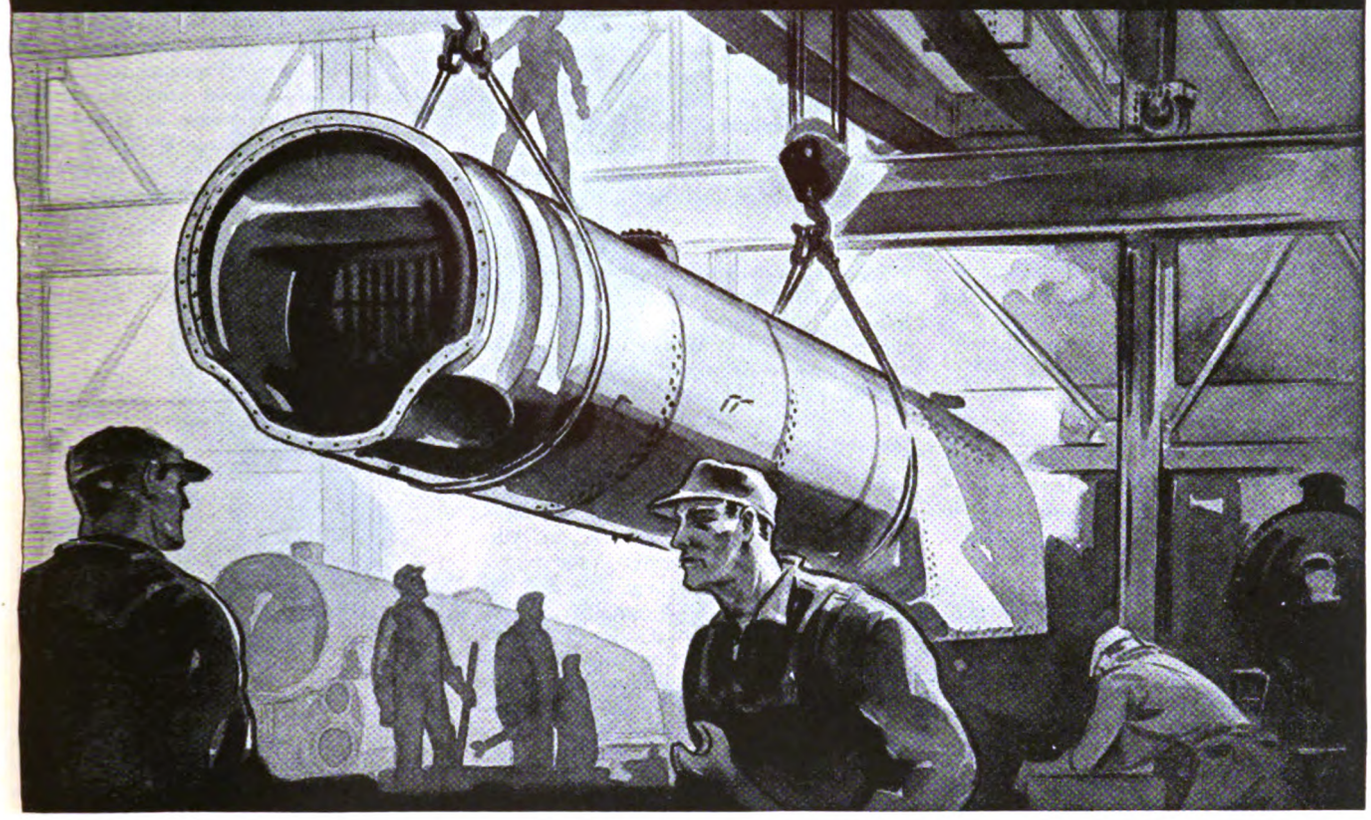


A. L. Humphrey

Quincy. His mechanical aptitude and ability to handle men were soon recognized and rapid advancement followed, leading him to places of continually growing importance in the mechanical division of seven different western railroads. While following his profession in Colorado he became interested in politics and was elected to the legislature, serving two terms, including one as speaker of the House. Later he became superintendent of motive power of the Chicago & Alton, which position he relinquished to join the Westinghouse Air Brake Company as western manager at Chicago in 1903. Two years later he went to Pittsburgh as general manager. Since then he has held the following positions: Vice-president and general manager, 1910; director, 1913; president, 1919; executive director, 1932. In addition Mr. Humphrey has many business connections including the following: Chairman of the board, Union Switch & Signal Company; Massey Concrete Products Corporation, Chicago; National Brake & Electric Company, Milwaukee, Wis.; First National Bank of Swissvale; Swissvale Trust Company; Westinghouse International Brake & Signal Company; Chairman of the executive committee and director, Pittsburgh Aviation Industries Corporation. Director, American Brake Company; American Brake Shoe & Foundry Company; Bendix Aviation Corporation, Chicago; Canadian Westinghouse Company, Ltd., Hamilton, Ont.; Federal Reserve Bank of Cleveland, Pittsburgh Branch; First National Bank of Pittsburgh; Pennsylvania Airlines, Inc.; Safety Car Devices Company; Union Trust Company of Pittsburgh; Westinghouse Pacific Coast Brake Company; Bendix-Westinghouse Automotive Air Brake Company; Westinghouse Air Brake Home Building Company. Vice-president and director, East Pittsburgh & Wilmerding Coal Company. Trustee, University of Pittsburgh.

(*Turn to next left-hand page*)

BETTER MATERIALS MAKE POSSIBLE HIGHER BOILER CAPACITY



Locomotives have practically reached the weight limits of roadbed and structures. « « « To increase boiler capacity, obtain greater tractive effort and still keep within weight restrictions, is the aim of designers today. « « « Agathon Alloy Steels are a valuable aid. They provide the essential higher strength, shock-resistance and anti-fatigue qualities in smaller-section, lighter-weight forgings. Savings of several tons of weight per locomotive are possible. « « « Whatever the weight-saving, it can be put into the boiler to increase its capacity and provide greater tractive effort—without exceeding weight limits. « « « Give careful consideration to Agathon Alloy Steels and their weight-saving possibilities on new power. Use them for replacements on existing locomotives, too! Here they assure greater forging dependability and safeguard operation. « « « « « « «

Toncan Iron Boiler Tubes, Pipe, Plates, Culverts, Rivets, Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel.

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES YOUNGSTOWN, OHIO

AGATHON STEELS
TRADE MARK

Obituary

JOSEPH L. TILLMAN, SR., vice-president of the Wine Railway Appliance Company, Toledo, Ohio, died on January 1.

ARTHUR A. BROWN, assistant to vice-president of the Westinghouse Electric & Manufacturing Company, died on December 19 at his home in Mount Vernon, N. Y.

ROBERT VINCENT DEVLIN, engineer of the industrial locomotive division of the General Electric Company, died at his home in Erie, Pa., on December 20.

FRANK L. NORTON, vice-president of the Scullin Steel Company, died suddenly on December 21 in his office in the Grand Central Terminal, New York.

C. D. ALLEN, district manager of the San Francisco (Cal.) branch of the Garlock Packing Company, Palmyra, N. Y., died on December 4 at Burlingame, Cal. Mr. Allen began his services with the Garlock Packing Company in March, 1903, as a clerk in the main office at Palmyra. He also served in the Cleveland branch, later becoming salesman at Cleveland, Ohio. He subsequently was consecutively manager for the same company of the Cleveland, Boston, Mass., New York and San Francisco branches. He had been on leave since August, 1932.

WILLIAM SHERWOOD BOSTWICK, of Waynesboro, Pa., formerly vice-president and general manager of Magnus Company, Inc., New York, died on November 28, at his home following a short illness. Mr. Bostwick was born at Duplain, Mich., on February 5, 1858. He went to Waynesboro in September, 1917, and with his son-in-law, Chester A. Lyon, took over the Waynesboro Foundry & Machine Company, under the name of Bostwick-Lyon Bronze Company. In 1923, the Bostwick-Lyon Bronze Company merged with the Chicago Bearing Metal Company, of which concern he was director and vice-president and three years later these companies merged with the Magnus Company, Inc. Mr. Bostwick had served as vice-president and general manager of the Magnus Company, Inc., and three years ago retired from active business.

THOMAS FINIGAN, first vice-president of the American Brake Shoe & Foundry Company, with headquarters at Chicago, died on December 25 of heart disease at his home in that city, at the age of 51 years. Mr. Finigan was born at Paterson, N. J., on September 26, 1882. In 1897 he entered the mechanical department of the Consolidated Traction Company at Newark, N. J. (now the Public Service Coordinated Transport) and later became assistant master mechanic, which position he held until 1902 when he entered the mechanical department of the United Railways at San Francisco, Cal. In 1906 he was in charge of rehabilitation work following the earthquake. Subsequently he served as purchasing agent and assistant general manager, in 1915 becoming Pacific Coast manager of the American Brake Shoe & Foundry Company, with headquarters at San Francisco. In 1918 he was elected vice-president, with headquarters at Chicago, which position he held until 1929 when he became first vice-president. Since 1920 Mr. Finigan had been president of the American Brake Shoe & Foundry Company of California, and since 1927 president of the American Brakeblok Corporation, automotive subsidiary of the American Brake Shoe & Foundry Company. He was a director of the American Brake Shoe & Foundry Company, the American Brakeblok Corporation, the American Brake Shoe & Foundry Company of California, American Forge Company, American Malleables Company, American Manganese Steel Company, National Bearing Metals Corporation, Racor Pacific Frog & Switch Company, Ramapo Ajax Corporation, and the Southern Wheel Company.

ARCHIBALD ALSTON STEVENSON, one of the pioneering leaders in the iron and steel industry, and formerly vice-president of the Standard Steel Works Company, died at his home in Ardmore, Pa., on December 15, after an illness of several months. The immediate cause of his death was pneumonia. Mr. Stevenson's entire life was spent in the iron and steel industry, and he was directly connected with many of its technical and engineering advances. He was born on April 10, 1862, at Allegheny, Pa., and was educated in the schools of Pittsburgh, Rock Island, Ill., and the University of Illinois. From 1881 to 1886 he was a draftsman at the Southwark Foundry & Machine Company, Philadelphia, Pa., then became affiliated with the Cambria Iron & Steel Company at Johnstown, Pa. There he worked with John Coffin on experiments with the Coffin toughened axles and forgings, and early in 1887 designed the furnace and equipment for their commercial treatment. This was one of the first uses of heat treatment on a large commercial scale in the United States. On August 1, 1888, he entered the employ of the Standard Steel Works Co., Burnham, Pa., and was with this company until his retirement in July, 1929. He served successively as traveling engineer, manager of wheel department, engineer, assistant superintendent, superintendent, and vice-president. From 1920 to 1929 he was in charge of manufacturing operations. Mr. Stevenson took an active part in the work of several engineering societies and clubs. He was a past-president (1916) and an honorary member (1927) of the American Society for Testing Materials, and was a member of its Executive committee from 1911 to 1920. He was the first chairman of its committee on Steel Wheels and Tires, serving in that capacity for 25 years. He was one of the A. S. T. M. representatives who, in 1916, with the representatives of the four Founder Societies (A.S.C.E., A.S.M.E., A.I.M.E., A.I.E.E.) instituted work which resulted in 1918 in the organization of the American Engineering Standards Committee, now the American Standards Association. Mr. Stevenson was very active in the work of this body and served as chairman in 1920 and 1921. He was a member of the American Society of Mechanical Engineers, American Institute of Mining & Metallurgical Engineers, American Iron & Steel Institute, American Society for Steel Treating and a past-president of the Association of American Steel Manufacturers.

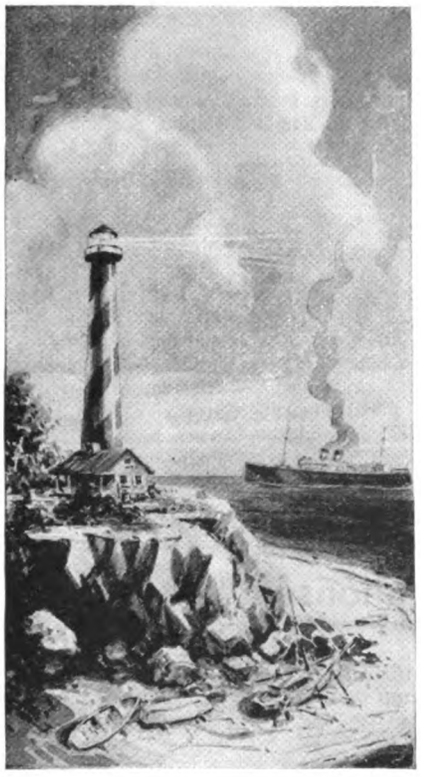
HERBERT THACKER HERR, vice-president of the Westinghouse Electric & Manufacturing Company, died after a short illness at his home in Philadelphia, Pa., on December 19. Mr. Herr was born on March 19, 1876, at Denver, Colo., and was graduated from the Sheffield Scientific School in 1899, winning the prize in mathematics and receiving the degree of bachelor of philosophy. Previous to entering college he had acquired some commercial and mechanical experience as a machinist apprentice on the Chicago & North Western. After his graduation he served two years as machinist and draftsman on the



Herbert Thacker Herr

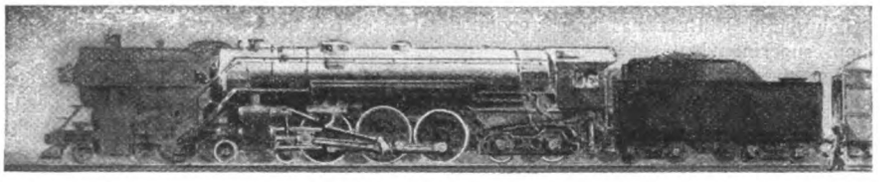
Denver & Rio Grande (now part of the Denver & Rio Grande Western) and acted also as chairman of a committee to revise the operating rules of that road. In 1902 he served as master mechanic on the Chicago Great Western, then on the Atchison, Topeka & Santa Fe, and later as general master mechanic of the Eastern division of the Norfolk & Western. He returned later to the Denver & Rio Grande as assistant to the vice-president, becoming general superintendent in 1906. Soon afterwards he retired from railroad work and in 1908 went to Pittsburgh, Pa., as general manager of the Westinghouse Machine Company. Shortly thereafter, he was promoted to second vice-president and general manager, and in 1913, became first vice-president and general manager. When this company was merged in 1917 with the Westinghouse Electric & Manufacturing Company he became vice-president of the latter and continued in that capacity until the time of his death, with headquarters at the South Philadelphia (Pa.) works. Mr. Herr invented various improvements in the design and construction of turbines, oil and gas engines and various ingenious air brake devices. He was a member of a number of technical societies, including the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Society of Naval Engineers, the Society of Naval Architects and Marine Engineers, the Society of Automatic Engineers, and the American Railway Guild.

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Lights that burned all day just to be ready for use at night would be an appalling waste.

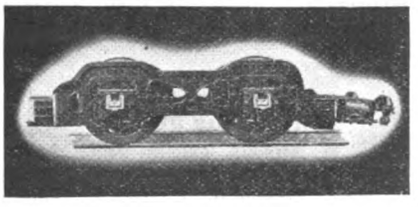
The BOOSTER Supplies Power *Only* When You Need It



It is a similar waste to build a locomotive with large cylinders and perhaps another pair of drivers just to provide power for starting. Then, the big cylinders continue to work all the rest of the trip when the peak power is not needed.

Rather use The Locomotive Booster to supply the power peaks and combine it with a smaller cylindered main engine. Once the need for the peak power has passed, The Locomotive Booster becomes inoperative. Then the smaller locomotive handles the train efficiently for the rest of the trip.

The combination of the Booster and smaller main engine cylinder results in reduced maintenance and increased operating efficiency.



FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

York

New York

Personal Mention

General

R. C. McINTYRE has been appointed superintendent of motive power of the Union Railroad, with headquarters at East Pittsburgh, Pa.

Master Mechanics and Road Foremen

BENJAMIN E. JONES has been appointed master mechanic motor equipment of the Erie and its subsidiaries, with headquarters at Susquehanna, Pa.

Car Department

D. C. TISCH, coach foreman of the Missouri Pacific at Sedalia, Mo., has been appointed assistant general passenger car foreman, with headquarters at Sedalia.

GEORGE E. ADAMS has been appointed division car foreman of the Erie, with headquarters at Pen Horn, N. J., succeeding Raymond Knorr.

RAYMOND KNORR has been appointed division car foreman of the Erie, with headquarters at Cleveland, Ohio, succeeding Townsend J. Bell.

GEORGE B. CARTWRIGHT, assistant general passenger car foreman of the Missouri Pacific at Sedalia, Mo., has been appointed general passenger car foreman, with headquarters at Sedalia.

Shop and Enginehouse

TOWNSEND J. BELL has been appointed shop superintendent of the Erie, with headquarters at Pen Horn, N. J., succeeding Joseph L. Ortner, resigned.

ALBERT HUBENER, general foreman of the Missouri Pacific at North Little Rock, Ark., has been promoted to the position of superintendent of shops at North Little Rock, to succeed G. T. Callender.

G. T. CALLENDER, superintendent of shops of the Missouri Pacific, at North Little Rock, Ark., has been transferred to the position of superintendent of shops at Sedalia, Mo., to succeed J. W. Lemon.

J. M. WATERS has been appointed general foreman of the locomotive department of the Illinois Central, with headquarters at East St. Louis, Ill., succeeding J. N. Fox, who has been transferred to Chicago.

Purchasing and Stores

W. H. MORRIS, general storekeeper of the Reading, has had his jurisdiction extended to include the Central of New Jersey. Mr. Morris's headquarters are at Reading, Pa.

J. D. LANDIS, purchasing agent of the Reading, has had his jurisdiction extended to include the Central of New Jersey. The office of manager of purchases and stores of the Central of New Jersey has been abolished. Mr. Landis' headquarters are at Philadelphia, Pa.

Obituary

HARRY E. ROUSE, formerly general storekeeper of the Chicago & Alton (now the Alton) and also of the Chicago Great Western, died on November 27 of blood poisoning at Washington, D. C.

A. P. HOUSHOLDER, mechanical superintendent of the Gulf Coast Lines and the International-Great Northern, whose death was noted in the December *Railway Mechanical Engineer*, entered railway service in 1894 as a machinist apprentice on the Southern at Knoxville, Tenn., becoming a machinist four years later. In 1899 he went with the Illinois Central as a machinist at Paducah, Ky., and in 1904 accepted a similar position with the Missouri Pacific at St. Louis, Mo. After two years Mr. Housholder was promoted to the position of enginehouse foreman at Jefferson City, Mo., later being transferred to St. Louis. In 1909 he returned to the Illinois Central as general foreman at East St. Louis, Ill., again going with the Missouri Pacific in 1912 as division foreman at Dupo, Ill. In 1919 Mr. Housholder was appointed master mechanic at Nevada, Mo. He served in this position at various points until September 1, 1926, when he was appointed mechanical superintendent of the Gulf Coast Lines and the International-Great Northern (subsidiaries of the Missouri Pacific).

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

GRINDERS.—"Railroad Set-Ups on the F. G. Micro Grinder" is the title of Bulletin No. 104 issued by the Micro Corporation, Bettendorf, Iowa.

ALUMINUM.—Revised editions of "The Welding of Aluminum" and "The Riveting of Aluminum" have been issued by the Aluminum Company of America, Pittsburgh, Pa.

DIES.—J & L tangent dies and ground thread chasers are illustrated and described in an eight-page catalog issued by the Jones & Lamson Machine Company, Springfield, Vt.

DIE HEADS.—Bulletin No. F-80, issued by the Landis Machine Company, Inc., Waynesboro, Pa., describes a new line of Lanco, Landmatic and Landex hardened and ground die heads.

GENUINE WROUGHT-IRON BILLETS.—A four-page folder, printed in red and black, issued by the A. M. Byers Company, Pittsburgh, Pa., describes Byers Genuine wrought-iron billets and illustrates the process of manufacturing.

TONCAN IRON PIPE.—Facts, figures and technical data on the manufacture, applications and performance of Toncan iron pipe are contained in the 24-page booklet issued by the Republic Steel Corporation, Youngstown, Ohio. Another booklet, "Toncan Iron for Permanence," gives information on corrosion-resisting Toncan iron pipe.

ENDURO.—The physical properties, fabrication, annealing, etc., of Enduro 4-6 per cent chromium steels are described in Form ADV. 220-B issued by the Republic Steel Corporation, Massillon, Ohio. These steels, which are available in all the usual forms, are resistant to corrosion, acid attack and scaling at elevated temperatures.

VALVES, FITTINGS AND PLUMBING FIXTURES.—Circular No. 300, issued by the Crane Company, 836 S. Michigan avenue, Chicago, illustrates Crane valves and fittings for use on locomotives and cars, and plumbing fixtures designed especially for railroad coaches. A selection of valves and specialties for railroad power plants, shops, enginehouses, yards, etc., are also shown.

BRONZE CASTINGS.—The Bronze Foundry Division of the Superheater Company at East Chicago, Ind., which is now producing a full line of bronze castings, rough or finished, is described in the 16-page bulletin, B-1, issued by the Superheater Company, 60 East Forty-Second street, New York. The castings are produced in standard bronzes, aluminum bronzes, and super-tensile manganese bronze under the trade name "Elesco".

RESULTS WITH NO-OX-ID.—A comprehensive booklet entitled "Proof of Results with No-Ox-Id in the Railroad Field" has just been issued by the Dearborn Chemical Company, 310 South Michigan avenue, Chicago. This illustrated booklet, containing 28 pages, shows the wide range of railway uses for this chemically-compounded rust preventive. Numerous applications to such parts as locomotive springs, tender coal space, stored car journals, water tanks, bridges, rail bonds, machine finished locomotive and car parts, stored piping, etc., are illustrated and described. The various adaptations of No-Ox-Id protection in the form of (1) a compound, made in various consistencies for all industrial conditions; (2) an impregnated wrapper covering for use under special conditions; (3) fillers and paint primers; and (4) quick-drying protective coatings for specialized interior and exterior use, are described in the booklet, which also contains a partial list of the railroads that have used No-Ox-Id protection in one form or another.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

February, 1934

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices,
30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: Terminal Tower
Washington: 17th and H Streets, N. W.
San Francisco: 58 Main St.

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The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.



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Why Any 10-Year Old Locomotive Is INADEQUATE

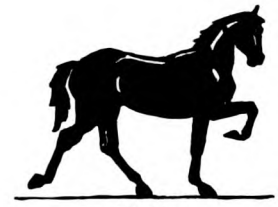
What Has Happened To HORSEPOWER!



1912
475 H. P.
per driving axle



1922
575 H. P.
per driving axle



1932
OVER 1,000 H. P.
per driving axle

What Has Happened To FUEL CONSUMPTION!



1912
6½ LBS. COAL
per drawbar horsepower



1922
5 LBS. COAL
per drawbar horsepower



1932
3 LBS. OR LESS
per drawbar horsepower

SO rapid has been the advance of locomotive design that not a single locomotive in this country over ten years old can begin to hold its own with the really up-to-date power plant on wheels known as the Super-Power locomotive.

LIMA LOCOMOTIVE WORKS
INCORPORATED

LIMA OHIO

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

February - 1934

Annual Report of the Bureau of Locomotive Inspection

Twenty-second annual report shows that record of consistent progress in locomotive defects begun in 1923 was broken by rise in year ended June 30, 1933

THE twenty-second annual report of A. G. Pack, chief inspector, Bureau of Locomotive Inspection, to the Interstate Commerce Commission shows that the record of improvement in the condition of steam locomotives and the casualties and accidents resulting therefrom which was begun in 1923 has been broken. The report covers the activities of the Bureau for the fiscal year ended June 30, 1933, and in the case of locomotives inspected and found defective the percentage rose from 8 to 10 per cent in the past fiscal year. The number of locomotives inspected by the Bureau during the past fiscal year was 87,658. Of these 8,388 were found defective. The total number of defects found increased from 27,832 in 1932 to 32,733 in 1933, and the number of locomotives ordered out of service because of defects increased from 527 to 544. The increase in accidents and casualties

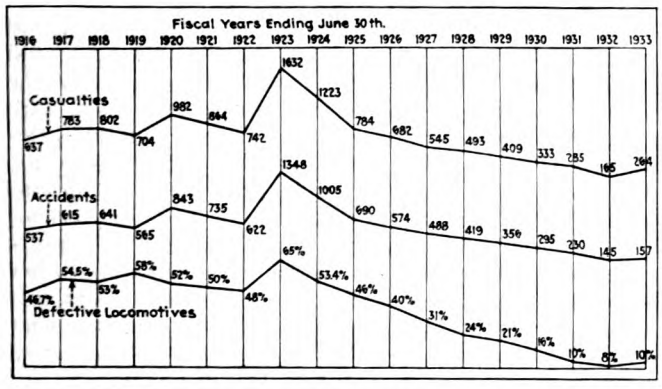
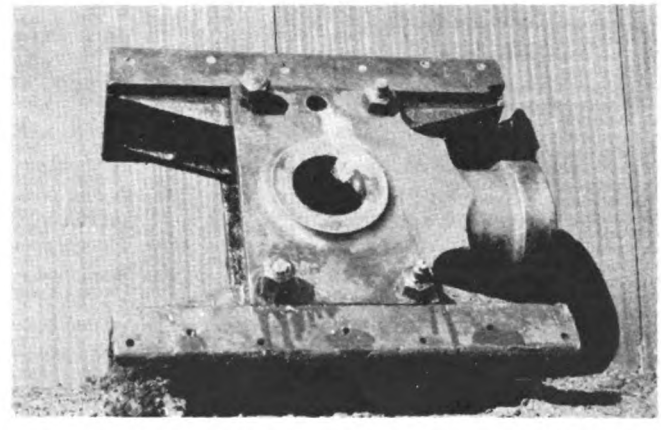


Chart showing the relation of defective steam locomotives to accidents and casualties resulting from locomotive defects

locomotives ordered out of service, the total number of defects found, and the number of accidents, the number of casualties all have likewise increased for the first time in the ten-year period. The total number of steam loco-



A crack in the pin boss of a crosshead caused by the application of fusion welding to reduce the diameter of the pin hole

brought about by the increase in defective locomotives and the converse are illustrated graphically in the chart accompanying this article.

Condition of Locomotives, Found by Inspection, in Relation to Accidents and Casualties

Fiscal year ended June 30	Per cent of locomotives inspected found defective	Number of locomotives ordered out of service	Number of accidents	Number of persons killed	Number of persons injured
1923	65	7,075	1,348	72	1,560
1924	53	5,764	1,005	66	1,157
1925	46	3,637	690	20	764
1926	40	3,281	574	22	660
1927	31	2,539	488	28	517
1928	24	1,725	419	30	463
1929	21	1,490	356	19	390
1930	16	1,200	295	13	320
1931	10	688	230	16	269
1932	8	527	145	9	156
1933	10	544	157	8	756

Boiler Explosions and Crown-Sheet Failures

There was a decrease of 16.6 per cent in the number of crown-sheet failures, a decrease of 71.4 per cent in the number of persons killed and a decrease of 33.3 per cent in the number of persons injured from this cause as compared with the previous year. Fatalities occurred

in two of the five crown-sheet failures caused by low water. Both of the locomotives involved were oil fired and in each instance the locomotive was in charge of an engine watchman who was killed. The assigned hours of each of these watchmen was such as to preclude the possibilities of obtaining sufficient rest without sleeping on duty. One of the watchmen was working on a tour of duty of 40 consecutive hours. The accident occurred at about the fourteenth hour of duty. The other watchman was assigned to shifts of 18 hours each, with six-hour rest periods intervening, and had been required to perform other service during his rest period. He had worked about 36 hours when the accident occurred.

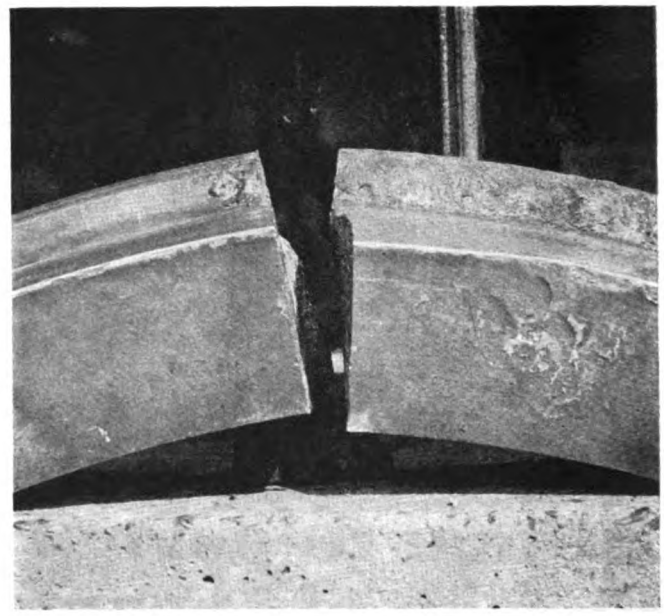
Extension of Time for Removal of Flues

A total of 1,400 applications were filed for extensions of time for the removal of flues as provided in Rule 10. The investigation of the Bureau disclosed that in 78 of these cases the condition of the locomotive was such that extensions could not properly be granted. Sixty-seven were in such condition that the full extensions requested could not be authorized, but extensions for shorter periods of time were allowed. Extensions were granted in 197 cases after the defects disclosed by the investigation had been repaired. Thirty-nine applications were canceled for various reasons. Applications were granted for the full period requested in 1,900 cases.

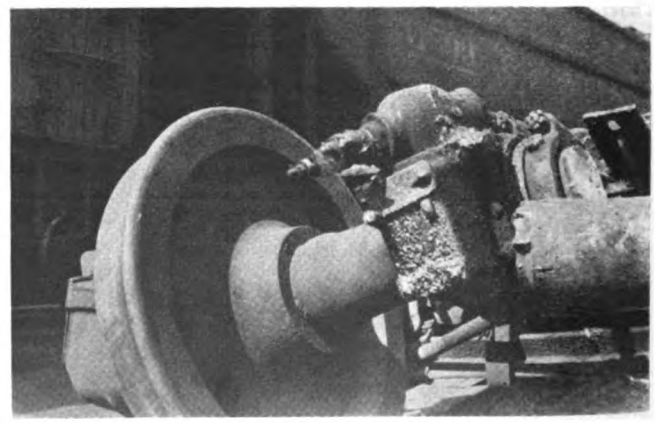
Under Rule 54 of the Rules and Instructions for Inspection and Testing of Steam Locomotives 151 specification cards and 3,601 alteration reports were filed, checked and analyzed. These reports are necessary in order to determine whether or not the boilers represented were so constructed or repaired as to render safe and proper service and whether the stresses were within the allowed limits. Corrective measures were taken with respect to numerous discrepancies found. Under Rules 328 and 329 of the Rules and Instructions for Inspection and Testing of Locomotives other than steam 98 specifications and 16 alteration reports were filed for locomotive units and 72 specifications and 71 alteration reports were filed for boilers mounted on locomotives other than steam. These were checked and analyzed and corrective measures taken with respect to discrepancies found. No formal appeal by any carrier was taken from the decisions of any inspection during the year.

Number of Steam Locomotives Reported, Inspected, Found Defective, and Ordered from Service

Parts defective, inoperative or missing or in violation of rules	Year ended June 30—					
	1933	1932	1931	1930	1929	1928
1. Air Compressors	474	417	481	873	1,202	1,282
2. Arch tubes	51	54	60	87	104	103
3. Ash pans and mechanism	40	69	81	76	132	133
4. Axles	21	13	10	12	20	7
5. Blow-off cocks	210	144	191	325	442	469
6. Boiler checks	293	214	263	521	761	914
7. Boiler shell	296	220	430	579	841	954
8. Brake equipment	1,696	1,645	1,923	2,706	3,894	5,214
9. Cabs, cab windows, and curtains	1,183	851	1,484	3,066	2,140	1,670
10. Cab aprons and decks	309	262	415	710	1,005	852
11. Cab cards	121	162	211	226	305	378
12. Coupling and uncoupling devices	67	85	98	122	154	179
13. Crossheads, guides, pistons, and piston rods	773	763	856	1,421	1,887	2,088
14. Crown bolts	67	50	96	95	129	164
15. Cylinders, saddles, and steam chests	1,084	841	1,265	2,311	3,210	3,264
16. Cylinder cocks and rigging	374	376	411	848	967	1,007
17. Domes and dome caps	76	45	83	154	227	281
18. Draft gear	318	325	568	950	1,310	1,453
19. Draw gear	357	371	640	1,003	1,367	1,650
20. Driving boxes, shoes, wedges, pedestals, and braces	1,080	821	925	1,359	1,993	1,990
21. Firebox sheets	246	235	341	471	657	730
22. Flues	150	120	187	254	334	464
23. Frames, tailpieces, and braces, locomotive	669	611	740	1,271	1,377	1,354
24. Frames, tender	80	86	105	177	297	256
25. Gages and gage fittings, air	145	156	192	290	309	461
26. Gages and gage fittings, steam	258	214	324	553	678	969
27. Gage cocks	388	330	415	783	1,114	1,413
28. Grate shakers and fire doors	245	288	410	767	295	377
29. Handholds	363	382	562	865	1,125	1,373
30. Injectors, inoperative	20	31	55	103	86	93
31. Injectors and connections	1,357	1,168	1,815	3,275	4,484	5,563
32. Inspections and tests not made as required	6,358	3,801	4,862	7,456	9,246	6,623
33. Lateral motion	269	237	289	372	618	699
34. Lights, cab and classification	76	55	77	119	121	118
35. Lights, headlights	169	119	180	373	488	571
36. Lubricators and shields	157	119	176	312	423	500
37. Mud rings	232	166	318	445	636	822
38. Packing nuts	419	402	523	828	991	1,265
39. Packing, piston rod and valve stem	592	444	706	1,429	1,708	1,904
40. Pilots and pilot beams	123	145	160	272	371	386
41. Plugs and studs	151	176	182	348	482	619
42. Reversing gear	254	202	299	579	788	967
43. Rods, main and side, crank pins, and collars	1,327	1,256	1,520	2,488	3,465	4,152
44. Safety valves	53	63	61	116	170	172
45. Sanders	376	289	314	804	1,008	1,031
46. Springs and spring rigging	2,122	1,851	2,161	3,311	4,557	4,939
47. Squirt hose	93	96	184	313	387	478
48. Stay bolts	219	181	293	395	542	590
49. Stay bolts, broken	368	552	938	1,098	1,197	1,867
50. Steam pipes	338	285	512	730	925	1,020
51. Steam valves	193	143	226	399	471	708
52. Steps	498	622	676	1,021	1,394	1,817
53. Tanks and tank valves	600	587	732	1,426	1,717	1,941
54. Telltale holes	90	108	151	183	174	241
55. Throttles and throttle rigging	448	434	574	1,175	1,554	1,889
56. Trucks, engine and trailing	664	648	714	1,141	1,605	1,914
57. Trucks, tender	747	766	1,059	1,531	2,144	2,610
58. Valve motion	640	520	497	827	1,067	1,262
59. Washout plugs	623	599	815	1,283	1,871	2,211
60. Train-control equipment	4	13	9	48	60	112
61. Water glasses, fittings, and shields	716	676	955	1,501	1,816	2,115
62. Wheels	580	603	750	1,025	1,325	1,609
63. Miscellaneous—signal appliances, badge plates, brakes (hand)	423	325	418	691	1,101	1,273
Total number of defects	32,733	27,832	36,968	60,292	77,268	85,530
Locomotives reported	56,971	59,110	60,841	61,947	63,562	65,940
Locomotives inspected	87,658	96,924	101,224	100,794	96,465	100,415
Locomotives defective	8,388	7,724	10,277	16,300	20,185	24,051
Percentage of inspected found defective	10	8	10	16	21	24
Locomotives ordered out of service	544	527	688	1,200	1,490	1,725



A driving-wheel tire that broke while an attempt was being made to build up the flange by fusion welding



A broken tender-truck axle caused by the application of fusion welding to attach brackets to the axle to prevent the retaining collar of train-control transmission from shifting on the axle

The Locomotive Smoke Nuisance*

Its elimination reduces fuel costs by increasing efficiency of combustion, and also removes prolific source of irritation

RAILROADS have been serious offenders because of smoke from the locomotives and at engine terminals. There was a time when general standards of cleanliness and neatness were such that nuisances of this sort were tolerated more or less as a necessary evil. Today, however, in most parts of the country such smoke is a constant source of irritation and does much to alienate the goodwill of that part of the public which is subjected to it. A number of cities, particularly the larger ones, have attempted to control the smoke nuisance, and in general with good results.

The railroads have the reputation for making much of the smoke in some communities, although, as a matter of fact, in many instances they are among the least important of the offenders from the standpoint of air pollution as a whole. Nevertheless, the dirt and the untidy appearance of many localities adjacent to engine terminals and yards, and along the right-of-way, cannot help but lower the morale of people living in such districts. Surely, also, it does not help the railroads in their fight to rebuild traffic and secure the goodwill of the public.

Meet the Smoke Expert!

I wondered what a typical Smoke Commissioner of a community which has achieved some considerable success in reducing the amount of smoke, might have to say as to how railway mechanical department officers and employees could co-operate to secure better results in the elimination of smoke, which because it is an indication of more efficient combustion, will reduce fuel expenses and at the same time eliminate criticism and condemnation on the part of the traveling public and the communities through which the railroad operates. I put this question squarely up to the Smoke Commissioner.

"In general," he replied, "we have received excellent co-operation from the railroads. One or two roads have practically eliminated smoke from locomotives. At the other extreme, however, are some which have evinced little interest and apparently we shall not get results unless we put on the spurs."

"Can you cite a specific instance of such lack of interest?" I asked.

Poor Judgment

"Surely," he replied. "Here, for instance, is a road that has a splendid reputation because of its excellent passenger service. Travelers on its trains are enthusiastic about the comfort of the equipment, the courtesy of the employees and the high standards and low cost of the dining car service. It has well designed locomotives, with large fireboxes, so that there should be excellent combustion with a minimum of smoke. For some reason, however, the officers and employees seem to be indifferent about the amount of smoke made by the locomotives; and, as you can see from the monthly statement, the road is well down the list on the basis of smoke elimination performance. Apparently the assumption is that if the travelers inside the cars can be protected, nothing else matters.

"As a matter of fact, however," he continued, "it must not be forgotten that there are many potential customers alongside the railroad that suffer from the needless smoke and dirt and therefore can hardly be expected to patronize or boost the railroad or be very much interested in seeing that it gets a square deal, either from the municipalities through which it operates or on the part of the state or federal authorities. It does seem to me that by co-operating with us in preventing smoke, the mechanical departments of the railroads can make friends for their roads and help to build up the traffic."

Induction Tubes and Ring Blowers

"Are there any mechanical contrivances which will automatically assist in reducing the amount of smoke?" I asked.

"Quite decidedly so," replied the Smoke Commissioner. "Interestingly enough, some of these devices are standard on some of the roads and are taken as a matter of course, while others lean back in a critical way, claiming that the devices are no good, and more or less of a nuisance. Take the matter of air induction tubes in fireboxes, for instance. It is not a very expensive job to install them and yet these tubes are a large factor in increasing the efficiency of combustion. Undoubtedly they will pay for themselves on this basis in a reasonably short time, and at the same time will go a long way toward eliminating smoke.

"Then there are the ring blowers, in place of the ordinary blower pipes in the front end. These make it possible to distribute the draft through the stack to better advantage, this in turn causing a better distribution of the air in the firebox, again improving the efficiency of combustion. The ring blower has another decided advantage. We have had many complaints because of the noise where ordinary draft pipes are used. This is greatly reduced and dampened by using ring blowers. Here, again, the blowers are not very expensive, should appeal to the managements from an engineering point of view, and undoubtedly, in addition to doing away with sources of irritation to the public, will pay for themselves in a reasonable time because of improved combustion."

Firing Up Locomotives

"How about smoke from the enginehouses?" I asked.

"The worst part of this smoke," replied the Smoke Commissioner, "is, of course, caused by the firing up processes. You must expect smoke—and plenty of black smoke—if you use oil saturated waste or oil in any form to start the fires. Many roads have greatly reduced the amount of smoke in the enginehouses by using dry wood for firing up purposes; mind you, I do not say *wood*, but *dry wood*. Sufficient coal is first placed

* Seventh of a series of interviews with men outside the mechanical department, commenting in a constructive way upon the possibilities of that department.

in the firebox to insure a good fire until the engine gets well out of the house. A shallow depression, deepening toward the middle, is formed in this coal bed and this is filled with dry wood. It does take a little more time to build the fire in this way, but it is time well spent because of the greater cleanliness in and about the enginehouse. Incidentally, little difficulty is found on most roads in gathering up a sufficient amount of wood for this purpose at low cost."

Stimulating Interest

"What other things would you suggest to help secure an improvement?"

"Obviously," replied the Smoke Commissioner, "we cannot expect to make any real and substantial improvement without first getting the men in the enginehouses and on the locomotives interested in the problem and thoroughly informed as to how to do their work in such a way as to reduce and eliminate the smoke. One road in our district, for instance, has a minimum of the mechanical contrivances I have mentioned, but the engine crews are intensely interested in the records that they are making, with the result that excellent performance is secured. Informal smoke meetings are held monthly at the terminal.

"It is, of course, our practice," he continued, "when we make a smoke reading and find a bad condition, to report immediately to the railroad concerned the number of the engine and the time that the reading was taken. If it is at all possible, our representative, when he takes the reading and sees that conditions are bad, will board the engine and try to explain to the crew how better results may be secured. At any rate, when a poor smoke reading is reported, it is the practice on some of the more interested roads to call the crew in and ask for an explanation. In some instances the brotherhoods, in order to protect their members, have been quite helpful in stimulating interest and encouraging the men to improve their practices."

"Can you induce a competitive spirit?" I asked.

"Yes," replied the Smoke Commissioner. "Because of a certain amount of friendly rivalry among some of the roads in our district, we are never quite sure as to exactly what the order of performance of the better roads will be on the monthly report. The only difficulty is that thus far we have been unable to stimulate all of the roads to this spirit of competition, and the tail-enders on the list have more or less consistently held that position for quite some time.

"On the other hand," continued the Commissioner, "it is significant that the combined record of all of the roads for the month of December last is by far the best that has ever been reported. For this reason I hope you will not think I have been too critical in my suggestions. It does indicate that all of the roads have co-operated to a greater or less extent and we are proud of the record that they have made. This, in turn, helps us to secure a greater amount of co-operation from the industrial plants in our district."

Locomotive Counterbalancing*

By Lawford H. Fry

A systematic method of analyzing the dynamic effects of rotating weights and of cross-balancing—The author points out the need for complete and accurate analysis, particularly where dynamic augment must be kept within rigid limits

IN modern locomotive designing the proper counterbalancing of the rotating and reciprocating parts deserves close attention. Methods used up to a few years ago are inexact and allow high unbalanced inertia forces with destructive effect on the track. In Europe the civil engineers of the railroads require all possible protection for the permanent way and as a result correct balancing of locomotives has been common practice. In recent years some locomotive engineers in this country have adopted methods of cross-balancing which have reduced the unbalanced inertia forces and have thus cut down the dynamic augment of wheel loads produced by these forces. However, the great majority of locomotives designed ten years or more ago are balanced for static conditions only. In these locomotives the main axle load on the track may be increased and decreased by 20,000 pounds or more during each revolution. Little argument should be needed to show the desirability of avoiding the large and unnecessary stresses thus imposed on the track.

Acceptance of this unnecessary dynamic augment in the axle load cannot be excused on the grounds of simplification of design. The great reduction in track stresses secured by elimination of unnecessary dynamic augment requires only that the counterbalance be set a few degrees off the center line of the crank. The necessary increase in weight of the counterbalance is small. Some refinements are necessary in weighing the wheels to see that they are correctly balanced. These, however, should present no real difficulty with adequate mechanical engineering talent and proper shop management.

It is occasionally argued that it is unnecessary to consider cross-balancing for certain types of locomotives because the wheel centers are too small to take all of the balance desired. This excuse is not valid. It is shown later that even with less than complete balance a shift of the center of gravity of the balance by about seven degrees may reduce the dynamic augment on the main axle by over 10,000 lb. The possibility of this reduction should not be neglected.

It is not easy to see why American civil and mechanical railway engineers have neglected for so long the

*A paper presented before the annual meeting of the American Society of Mechanical Engineers, December 5, 1933. Contributed by the Railroad Division.

proper balancing of locomotives. Probably one reason for this neglect has been the lack of a simple method for analyzing the inertia forces and presenting the facts. The present paper attempts to fill this gap. It offers a complete and accurate method for analyzing the inertia effects of the rotating parts of a locomotive engine. The method serves a double purpose. In the first place, it shows exactly what unbalanced inertia forces are developed by a given locomotive. In the second place, it enables a designer to arrange the counterbalance of a locomotive so as to secure the best possible results for any given conditions.

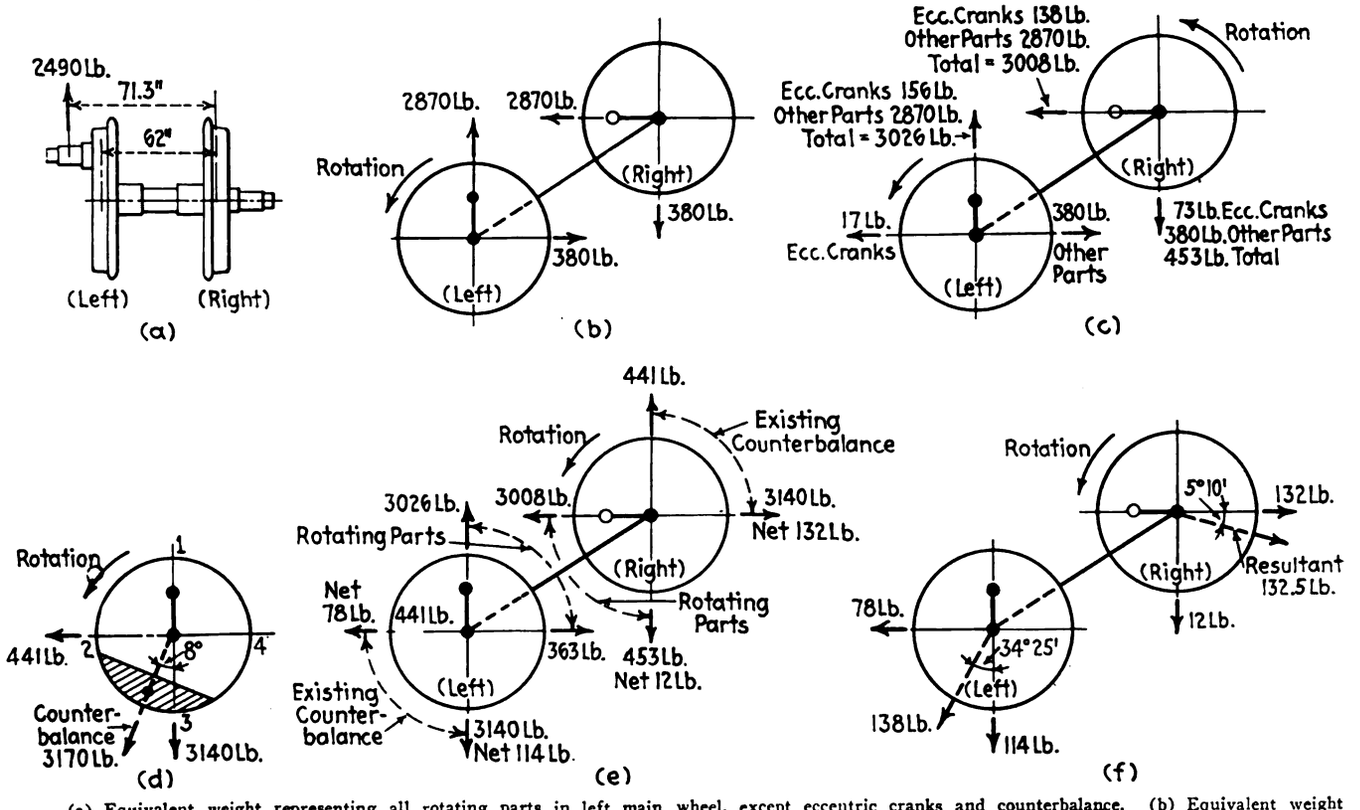
The paper describes in detail all of the computations to be carried out and keeps the mathematics down to the inescapable minimum. The final results are presented in simple form so that they may be readily understood by executives too busy to unravel the usual intricacies of cross-balancing.

It is believed that general use of this method will accelerate the progress in improved balancing that has begun in the last few years. The present interest in the reduction of track stresses by proper balancing is directly traceable to the track stress measurements begun in 1913 by Prof. A. N. Talbot for the American Railway Engineering Association. C. T. Ripley of the Atchison, Topeka and Santa Fe co-operated with Prof. Talbot in this work and was much impressed by advantages to be gained by designing locomotives to reduce track stresses. Improved distribution of weight and elimination of flangeless tires were tried and found to be efficacious. Prof. Talbot's tests also showed the large unnecessary stresses were due to imperfect balancing of locomotives. In 1924 Mr. Ripley arranged for the cross-balancing of a large Santa Fe type locomotive and the writer worked with Mr. Ripley on the preliminary computations of the balance for this engine. In 1926 Mr. Ripley reported to the American Railway Association, Mechanical Division, that the experimental locomotive gave a satisfactory reduction in track stresses. On this foundation a considerable amount of improvement in locomotive balancing has been built. In 1930 the Committee on Locomotive Construction reported to the American Railway Association, Mechanical Division, a proposed method for dynamic or cross-balancing and in 1932 the Committee's method was adopted by the Association as Recommended Practice.

The present paper starts with the American Railway Association method of computation and modifies and extends this. In addition a method is provided for a complete analysis of the inertia forces of an existing locomotive. Special attention is called to the method of presenting the results of this analysis. Although entirely accurate, the results are presented in very simple form.

Systematic Method of Counterbalance Analysis

In each pair of wheels all of the inertia forces of the rotating parts and of the counterbalances are combined so that they are completely represented by two equivalent weights in each wheel. These weights act in the plane of rotation of the center of gravity of the counterbalance. In this plane one equivalent weight acts along the wheel diameter through the crank pin and the other perpendicular to this diameter. When this pair of representative equivalent weights is set down for each wheel, as shown in Fig. 2, the exact conditions of balance of the locomotive can be seen very readily. The equivalent weight acting along the crank diameter represents, in each wheel, the over-balance or under-balance acting to balance or to reinforce the inertia forces of the reciprocating parts. The equivalent weight acting at right angles to the crank is a parasitic effect due to incomplete cross-balancing. The resultant of the two equivalent weights at right angles to each other, shown by broken lines in Fig. 2, determines the maximum value of the dynamic augment. If the parasitic



(a) Equivalent weight representing all rotating parts in left main wheel, except eccentric cranks and counterbalance. (b) Equivalent weight in counterbalance planes representing all rotating parts, except eccentric cranks and counterbalances. (c) Equivalent weight representing eccentric cranks and all other rotating parts, except counterbalances. (d) Equivalent weight and position of existing counterbalance and component equivalent weight representing counterbalance. (e) Component equivalent weights representing all rotating parts, including counterbalances. (f) Component and resultant equivalent weights in counterbalance planes of main wheels representing combined effect of all rotating parts, including counterbalances.

Fig. 1—Analysis of inertia effects in main wheels

effect is large enough to produce an undesirably large increase in the dynamic augment, it can be reduced by cross-balancing.

With this as introduction, the method proposed by the author will be considered in more detail. The method is described by using it to analyze the inertia forces set up by the rotating parts of an existing 4-8-2 type of locomotive. This engine which has been in satisfactory service for about six years has the main pair of driving wheels partially cross-balanced. The locomotive is of the 4-8-4 type with dimensions as follows:

Cylinders:	
Diameter	30 in.
Stroke	30 in.
Driving-wheel diameter	73 in.
Weight:	
First pair of drivers	66,500 lb.
Second pair of drivers (main axle)	70,500 lb.
Third pair of drivers	66,500 lb.
Fourth pair of drivers	66,500 lb.
Total on drivers	270,000 lb.
Total locomotive	420,000 lb.

When the original design of the locomotive was under consideration it was stipulated that at diameter speed, that is at 73 miles per hour, the combined static and dynamic rail load of any axle should not exceed 75,000 lb.

This is a highly intelligent method of setting the limits to be worked to in counterbalancing. After each static axle load has been established, the difference between this static load and the permissible maximum of 75,000 lb. is the maximum allowable dynamic augment permitted for the axle in question. From this can be computed the amount of over-balance which may be put into each wheel to balance the reciprocating parts.

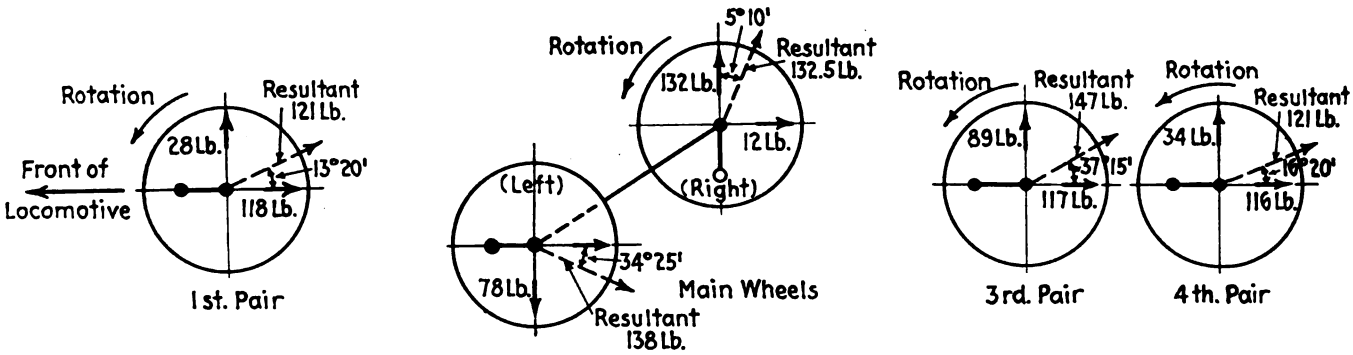
The locomotive under consideration had the main wheels partially cross-balanced. The analysis which follows shows that the final results in this pair of wheels differed somewhat from that aimed at. The deviation is due to two causes. In the first place, the eccentric cranks were assumed to be concentrated at the crank pin, while the present more accurate analysis takes into account the fact that the center of gravity of the eccentric cranks does not fall on the main crank radius. In the second place, the position of the counterbalance to give correct cross-balance for the rotating parts was determined and the over-balance for the reciprocating parts was then added without changing the position of the counterbalance.

The difference between the result aimed at and that obtained is not large, but is sufficient to show that any counterbalance scheme should be accurately analyzed before the locomotive design is accepted as satisfactory.

All computations necessary for an accurate analysis of the system of rotating parts are described in detail in the Appendix.* A step by step method is used so that those who carry out such computations infrequently may be able to follow the reasoning involved.

Before considering the application of the method to the example, a word of explanation of the term "equivalent weight" is in order. This term has been introduced to simplify the mathematics and to avoid the necessity for introducing the speed of the locomotive. Instead of calculating with "masses" or with "centrifugal forces", the "equivalent weights" are used. The inertia effect of each rotating mass is represented by its equivalent weight. Equivalent weight is defined as the weight of that mass which, rotating at crank radius about the axis of the axle, produces the same centrifugal force as the mass represented. The equivalent weight is assumed to act radially through the center of gravity of the mass it replaces.

If their positions, directions and magnitudes are taken into account, the various equivalent weights can be resolved and combined just as though they were forces. They, of course, represent forces which are proportional to their magnitudes and to the square of the speed of



Line			1st. Pair	Main Wheels		3rd. Pair	4th. Pair	
				Left	Right			
1	Resultant Equivalent Weight Producing Dynamic Augment		Lb.	Lb.	Lb.	Lb.	Lb.	
			121	138	132.5	147	116	
2	Dynamic Augment at Diameter Speed	Per Wheel	5800	6630	6360	7050	5800	
3		Per Axle	8200	6570		9950	8200	
4	Static Axle Load		66500	70500		66500	66500	
5	Maximum Combined Static and Dynamic Axle Load at Diameter Speed		74700	77070		76450	74700	Total Overbalance
6	Equivalent Weight Opposing Reciprocating Parts		118	114	132	117	116	465 Lb. Left 483 Lb. Right

Fig. 2—Component and resultant equivalent weights representing unbalanced inertia forces

* The Appendix will be printed in the next issue.—Editor.

rotation of the wheel. To speak mathematically, they are vector quantities.

We now consider the processes by which, in each pair of wheels, the inertia effects of all rotating parts, including the counterbalances, are resolved into and represented by two pairs of equivalent weights. One pair acts in each wheel in the plane of rotation of the center of gravity of the counterbalance. In each of the counterbalance planes, one equivalent weight of the pair acts along the diameter through the crank pin with the other weight of the pair acting at right angles to this diameter.

Unsymmetrical Effect of the Eccentric Crank

The main pair of wheels is taken as an example. Weights and positions of the rotating masses are assumed to be as given in the Appendix. Steps in the analysis are illustrated in Fig. 1. First, by the method of Section I of the Appendix, all rotating parts in one wheel, except eccentric cranks and counterbalance are replaced by a single equivalent weight of 2,490 lb. acting in a plane 71.3 in. from the central plane of the counterbalance in the opposite wheel. See Fig. 1(a). The distance between the central counterbalance planes is 62 in. This resultant equivalent weight of 2,490 lb. must be resolved into two components, one in each counterbalance plane, as described in Section II of the Appendix. When this is done for both wheels of the pair, each wheel has an equivalent weight of 2,870 lb. acting along the crank radius, and an equivalent weight of 380 lb. at right angles to the crank, as shown in Fig. 1(b). The inertia effect of the eccentric cranks must now be similarly resolved into two equivalent weights in each counterbalance plane. The method of computation is described in Section III of the Appendix. The results are shown in Fig. 1(c), together with the component equivalent weights already found for the other rotating parts. In the left main wheel the inertia effect of the eccentric cranks is represented by two equivalent weights. One weight of 156 lb. acts along the crank radius. The other of 17 lb. acts along the radius 90 deg. ahead of the crank. In the right wheel, the components for the eccentric cranks are 138 lb. along the crank radius and 73 lb. at 90 deg. ahead of the crank. Owing to the position of the eccentric cranks, their effect is not symmetrical in the two wheels of the pair.†

Combining the components of eccentric cranks and other rotating parts, the result is set down as in Fig. 1(c) and to this, the inertia effect of the counterbalance as determined below is added. The locomotive under analysis had in each main wheel a counterbalance with an equivalent weight of 3,170 lb. with its center of gravity set in each wheel 8 deg. behind the crank diameter. See Fig. 1(d). This can be resolved into two components at right angles to each other, as shown in Fig. 1(e). The detailed method for this resolution of the counterbalance effect into two component equivalent weights is given in Section VII of the Appendix. These components are an equivalent weight of 3,140 lb. along the crank diameter opposite the main pin and another equivalent weight of 441 lb. 90 deg. behind the first.

It is now only a matter of simple subtraction to arrive at the final result of Fig. 1(f). The unbalanced inertia effect of all rotating parts including eccentric cranks and counterbalance in the left counterbalance plane is represented by an equivalent weight of 114 lb. along the crank diameter opposite the main pin and 78 lb. at 90 deg. back of this. In the right hand counterbalance plane the unbalanced inertia effects are represented by an equivalent weight of 132 lb. opposite the right-hand crank pin and an equivalent weight of 12 lb. acting 90 deg. back of this.

Fig. 1(f) gives a complete representation of the unbalanced inertia forces in the main wheels. All rotating parts including eccentric cranks and counterbalances are covered. In each counterbalance plane there are two component equivalent weights at right angles to each other. These can be combined into a single resultant as shown.

The main pair of wheels being disposed of, the other coupled wheels must be dealt with in the same way. It is convenient to use a blank form similar to Fig. 1 for setting down the various steps in the calculation, omitting details which pertain only to the main wheels. Details of the computations are not given here, but the final results for the four pairs of main and coupled wheels are shown in Fig. 2. Except in the case of the main pair of wheels, the right and left hand wheels on each axle have the same equivalent weights and therefore only one wheel of each pair is shown. The lack of symmetry in the main wheels is due, as explained above, to the position of the eccentric cranks.

It is important to use a form similar to that of Fig. 2 for showing the results obtained, as this gives complete information regarding the unbalanced inertia forces in the simplest possible form. The information thus given puts the locomotive designer in a position to give critical consideration to the balance system which has been applied or which is proposed for application.

The balancing of the locomotive under consideration will now be reviewed. Two points are of major importance, the dynamic augment and the amount of balance provided for the reciprocating parts.

Dynamic Augment

The force producing dynamic augment in each wheel is proportional to the resultant equivalent weight shown for that wheel in Fig. 2. This force is computed from the resultant equivalent weight by the usual formula for centrifugal force:

$$F = 0.0000284\ W\ R\ n^2$$

where F = force in pounds
W = equivalent weight in pounds
R = crank radius in inches
n = revolutions per minute

At diameter speed the wheels make 336 r.p.m. At this speed the centrifugal force is:

$$F = 3.2\ R\ W$$

For the locomotive under consideration, which has a crank radius of 15 in., this equation takes the form

$$F = 48\ W$$

That is, the maximum dynamic augment in each wheel is 48 times the resultant equivalent weight in that wheel. Values corresponding to this are shown in line 2 of the tabulation in Fig. 2 for all of the wheels. The values here are the maximum values of the force which alternately increases and decreases the wheel load on the rail during each revolution. The maximum increase, or maximum dynamic augment, occurs in that position of the wheel in which the resultant equivalent weight is directed vertically downward. It is evident that the maximum values for right and left hand wheels on one axle do not occur at the same time. Consequently, the maximum increase in axle load is not the sum of the maximum increases in the two wheels. Section V of the Appendix gives a method for determining the maximum axle load and the corresponding position of the wheels when the resultant equivalent weights in the two

† The author is indebted to C. H. Bilty, mechanical engineer, Chicago, Milwaukee, St. Paul & Pacific, for calling attention to the desirability of considering the eccentric cranks separately from the other revolving parts on the crank pin.

wheels are different and are set at any angle. If the resultant equivalent weights are the same in both wheels of a pair and act at 90 deg. apart, the maximum axle load occurs when the resultants in both wheels are directed downwards at an angle of 45 deg. from the vertical. The maximum dynamic augment for the axle is then 1.414 times the maximum for each wheel. In the locomotive under consideration this is the case for all of the coupled wheels except the main pair.

In the main pair of wheels, the planes through the resultant weights and the axis of the axle stand at an angle of 119 deg. 15 min. and the resultants have the values of 138 lb. in the left and 132.5 lb. in the right wheel. By applying the method of Section V of the Appendix, it is found that the equivalent weight producing the maximum axle load is 137 lb. This does not differ greatly from the individual resultants in the wheels.

It should be noted that the relation between maximum axle load and maximum wheel load depends on the angle between the wheel resultants. The extreme cases are (1) with zero angle betwen the resultants the increase in axle load is twice the wheel load, and (2) with 180 deg. between the resultants the increase in axle load is zero.

If the angle between the resultants is large, so that the increase in axle load is small, it will probably be desirable to consider the increase in wheel load as the limiting factor rather than the increase in axle load. The axle load measures the influence of the locomotive on a track unit such as a bridge, while the wheel load determines the influence on an individual rail.

Overbalance for Reciprocation Parts

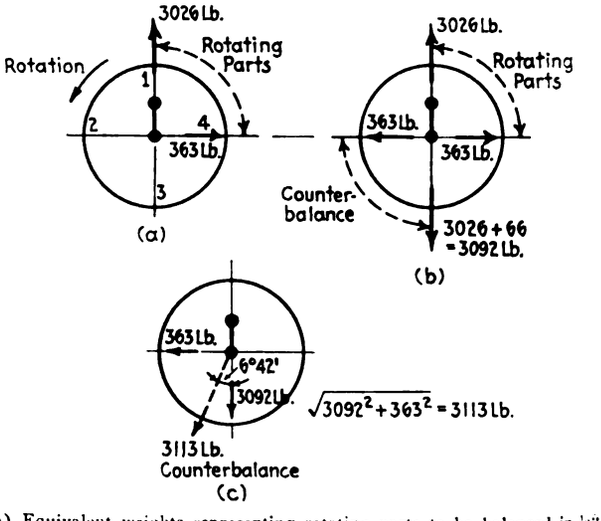
Returning to a consideration of Fig. 2: Line 3 shows the maximum dynamic augment per axle at diameter speed and line 4 shows the static axle load. Line 5, the sum of the two preceding lines, gives the maximum combined static and dynamic axle load at diameter speed. It was intended when designing the locomotive that this combined axle load should not exceed 75,000 lb. This limit is observed in the front and back wheel pairs, but is slightly exceeded in the main and third pairs of wheels. If an analysis had been made in this form before the locomotive had been built, it would have been a simple matter to determine the weight and position of counterbalances which would keep to the desired axle load.

The general method is described in Section VI of the Appendix. In the main axle, the maximum dynamic augment permissible is 75,000—70,500 = 4,500 lb. This corresponds to an equivalent weight of 94 lb. on the axle. If the resultants in the wheels are equal and act at 90 deg. apart, the value of each will be 66.3 lb.* Assume then that each of the main wheels is to be balanced so that the resultant producing dynamic augment in the wheel is 66 lb. It is desirable to eliminate any parasitic effect and to have the full weight of this resultant acting opposite the crank pin so as to be available for balance of the reciprocating parts.

In the left main wheel, the rotating parts are represented as shown in Fig. 3(a) by equivalent weights of 3,026 lb. along the crank diameter and 363 lb. acting 90 deg. back of this. To produce the desired balance, the components of the counterbalance must be 363 lb. opposing the same weight at right angles to the crank, and 3,026 + 66 = 3,092 lb. opposite the pin as shown in Fig. 3(b). These components when combined as in Fig. 3(c) show that the counterbalance itself must have an equivalent weight of 3,113 lb. with its center of gravity set 6 deg. 42 min. back of the crank diameter. Comparing this with the counterbalance as applied, it is seen that by reducing the equivalent weight from 3,140 lb. to 3,113 lb. and changing the angle from 8 deg. to 6 deg. 42 min., the unbalanced resultant equivalent weight is reduced from 138 to 66 lb. with a reduction of 3,350 lb. in the dynamic augment of the wheel at diameter speed.

This illustration shows that when the present method is used to resolve the inertia effects into two equivalent weights in each wheel, it is a very simple matter to determine the balance required to meet any desired conditions.

By applying the same method to the right hand main wheel, it is found that for complete balance except for an over-balance of 66 lb. opposite the pin, the counterbalance must have an equivalent weight of 3,107 lb. set 8 deg. 23 min. off the diameter. The difference between the counterbalance found for the right and left hand main wheels is not large. It is desirable for practical



(a) Equivalent weights representing rotating parts to be balanced in left main wheel. (b) Component equivalent weights representing rotating parts and desired counterbalance. (c) Components and resultant equivalent weight giving counterbalance desired.

Fig. 3—Determination of counterbalance to give complete cross-balance and desired over-balance of 66 lb.

reasons of manufacture to make both wheels the same. A satisfactory balance can be obtained by giving the actual counterbalance in both wheels an equivalent weight of 3,110 lb. set at an angle of 7 deg. 30 min. off the diameter. This weight and angle are obtained by averaging the values found as above for the right and left hand wheels. With this counterbalance the left wheel will have an over-balance of 56 lb. and a resultant of 71 lb., while the right wheel will have an over-balance of 74 lb. and a resultant of 87 lb. The left wheel is slightly under and the right wheel slightly over-balanced, but the difference is not serious.

In addition to the main pair of wheels, it will be seen from Fig. 2 that the third pair also exceeds the proposed limit of 75,000 lb. for combined static and dynamic load. The dynamic augment exceeds the estimated figure by 1,450 lb. because the wheels were not cross-balanced. Cross-balancing would have involved changing the equivalent weight of the counterbalance from 1,130 to 1,133 and moving its center of gravity 4 deg. 30 min. away from the crank diameter. This would eliminate the parasitic effect of 89 lb., leaving the over-balance the same, 117 lb., and reducing the resultant producing dynamic augment from 147 to 117 lb. This reduction of 20 per cent in the dynamic augment is well worth considering if the locomotive is being built to a closely restricted weight.

In the fourth pair of wheels, the desired over-balance

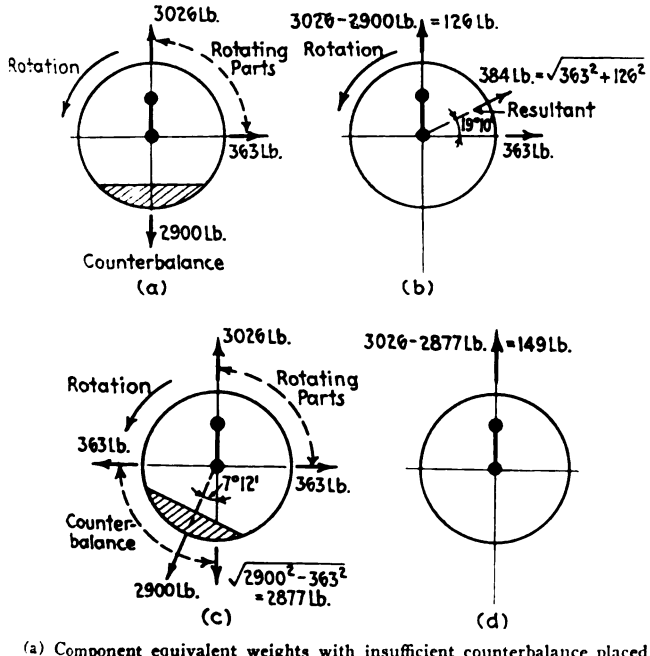
* 94 ÷ 1.414 = 66.3.

opposite the crank pin is 116 lb. The parasitic effect which could be eliminated by cross-balancing, is 34 lb. These produce a resultant of 121 lb. Cross-balancing by eliminating the parasitic 34 lb. would reduce the equivalent weight producing dynamic augment from 121 to 116 lb., that is by only 4.1 per cent. The reduction is hardly enough to be worth while.

As a general rule, it may be noted that unless the parasitic effect to be eliminated by cross-balancing amounts to more than 30 per cent of the over-balance the reduction in the resultant produced by cross-balancing will not be more than 4.5 per cent, and therefore hardly justifies the additional complication.

Cross-Balancing with Small Wheels

Before leaving the balance of rotating parts, consideration must be given to the desirability of cross-balancing when the wheel centers are too small to allow the full amount of balance to be applied. Assume that in a main wheel the component equivalent weights representing the rotating parts are as found for the left main wheel of the locomotive already examined, that is 3,026 lb. along the crank radius and 363 lb. at right angles to this. Assume also that the wheel design limits the equivalent weight of the counterbalance to 2,900 lb. If this is put exactly opposite the pin as in Fig. 4(a), it is obvious that the unbalanced components will be as in Fig. 4(b), 126 lb. along the crank and 363 lb. at 90 deg., giving an unbalanced component of 384 lb. producing dynamic augment. This can be reduced materially by shifting the equivalent weight of 2,900 lb. 7 deg. 12 min. off the crank diameter. As shown in Fig. 4(c) this gives components of 2,877 pounds opposite the pin and 363 lb. at right angles to this. The position is chosen so the component at right angles to the crank diameter is just equal and opposite to the component of the rotating parts acting at right angles to the crank. The simple calculation required to determine the other component is obvious from Fig. 4(c). The components being 363 and 2,877 lb., the tangent of the angle at which the counterbalance must be set at $363 \div 2{,}877 = 0.1265$, which is the tangent of 7 deg. 12 min. Combination of the four components in Fig. 4(c) shows that the net unbalanced equivalent weight is 149 lb., as in Fig. 4(d), instead of 384 lb. when the counterbalance was directly opposite the pin as in Fig. 4(a). This large reduction in the unbalanced force producing dynamic augment makes cross-balancing well worth while even though full balancing is not possible.



(a) Component equivalent weights with insufficient counterbalance placed opposite crank pin. (b) Component and resultant equivalent weights representing unbalanced inertia forces of arrangement (a). (c) Position of insufficient counterbalance to give least possible unbalanced inertia forces. (d) Net equivalent weight representing unbalanced inertia force resulting from arrangment (c).

Fig. 4—Incorrect and correct positions for insufficient counterbalance

Consideration must now be given to the over-balance provided for the reciprocating parts. Fig. 2 shows that the over-balance amounts to 465 lb. on the left and 483 lb. on the right hand side. The locomotive under consideration had reciprocating parts weighing 2,241 lb. on each side of the engine. Approximately 80 per cent of the weight of the reciprocating parts is unbalanced. This is very much more than the 50 per cent set up by the American Railway Association as recommended practice. In spite of this, the locomotive rides satisfactorily.

The fact is that the A. R. A. practice needs further consideration. In the first place, there is no logical reason for specifying the over-balance as a percentage of the weight of the reciprocating parts. The proper course is to consider the unbalanced weight in comparison with the total weight of the locomotive. The unbalanced portion of the reciprocating parts tends to shake the locomotive. This shaking is resisted by the inertia of the locomotive as a whole. Consequently the stability of the locomotive is determined by the relation of the mass of the whole locomotive to the mass of the unbalanced parts. This principle was stated by George R. Henderson over twenty-five years ago, but has not received the recognition it deserved.

Henderson suggested that one four-hundredth of the weight of the locomotive might remain unbalanced on each side. That would be 2.50 lb. unbalanced per 1,000 lb. of locomotive weight. The 4-8-4 type locomotive analyzed has 4.2 lb. unbalanced per 1,000 lb. Other locomotives analyzed in the same way show unbalanced weights of 5.4 lb. per 1,000 for a 2-8-4 type and 3.8 lb. per 1,000 for a 4-6-4 type. All are reported to ride satisfactorily.

The conclusion to be drawn is that if the rotating parts are properly balanced, it is only necessary to balance a comparatively small portion of the reciprocating parts.

Further study of results obtained in practice is desirable, but if the reports of such results are to have any value they must be based on an accurate analysis of the balance similar to that which has been described.

To complete this examination of the inertia forces it is necessary to take into account the fact that the inertia forces of the reciprocating parts act in the vertical plane through the center of the main rod while the inertia force of the over-balance acts in the central plane of the counterbalance. This difference in plane can usually be neglected. Its effect is to tend to turn the locomotive about a vertical axis. This tendency will have no perceptible effect on a long modern locomotive. In adjusting the over-balance to offset the inertia forces of the reciprocating parts, it is only necessary to consider the longitudinal forces. The couple about the vertical axis due to the difference between the planes of action can be neglected. Cross-balance is therefore not necessary for the over-balance for the reciprocating parts.

In conclusion, the author repeats what he has said before in addressing the society. It is important for railroad engineers to adopt an accurate method for analyzing the balance of a locomotive. It is also highly important that the results obtained by the analysis be stated in a simple manner free from involved mathematics. If this is done, the advantages of proper balancing methods will be self-evident and improvements will follow.

Air-Conditioned Passenger Cars in Service in the United States, December 31, 1933

Railroad	No. of cars	Type of cars	Date equipped	Type of system	Manufacturer of system	Compressor drive	Generators: No.	Generators: Capacity, kw.	Generators: Type of drive	Generators: Type of mounting	Refrigerant	Storage batteries: Make	Storage batteries: Amp.-hr. capacity	Outside power supply: Current Characteristics: a. c. or d. c.	Phase	Cycles	Volts	
Alton	4	Diners	7-1932	Mech.	B. & O.—York	5-hp. motor	2	1—4 1—7½	Flat belt Belt and gear	Body	Freon	Exide	1,000	d. c.	....	....	32	B. c. r.*
	4	Coaches	7-1932	Mech.	B. & O.—York	5-hp. motor	2	1—4 1—7½	Flat belt Belt and gear	Body	Freon	Exide	1,000	d. c.	....	....	32	B. c. r.
	6	Parlor	7-1932	Mech.	B. & O.—York	5-hp. motor	2	1—4 1—7½	Flat belt Belt and gear	Body	Freon	Exide	1,000	d. c.	....	....	32	B. c. r.
	2	Obs.-Lounge	7-1932	Mech.	B. & O.—York	5-hp. motor	2	1—4 1—7½	Flat belt Belt and gear	Body	Freon	Exide	1,000	d. c.	....	....	32	B. c. r.
A. T. & S. F.	1	Diner	7-1930	Mech.	Carrier	Motor	2	7½	Gear	Truck	Ammonia	Exide	2,250	d. c.	....	....	32	B. c. r.
	22	Diners	1932	St. eject.	Safety C. H. & L.	.....	1 1	2 4	Flat belt Flat belt	Truck	Water	Exide	900	d. c.	....	....	32	B. c. r.
B. & O.	32	Diners	1931-1933	Mech.	B. & O.—York	5-hp. motor	1 1	4 7½	Flat belt Belt and gear	Body	Freon	Exide—USL and K. W.	576—864 and 1,000	d. c.	....	....	32	B. c. r.
	13	Coaches	1931-1933	Mech.	B. & O.—York	5-hp. motor	1 1	4 7½	Flat belt Belt and gear	Body	Freon	Exide—USL and K. W.	576—864 and 1,000	d. c.	....	....	32	B. c. r.
	8	Reclin. chair	1931-1933	Mech.	B. & O.—York	5-hp. motor	1 1	4 7½	Flat belt Belt and gear	Body	Freon	Exide—USL and K. W.	576—864 and 1,000	d. c.	....	....	32	B. c. r.
	5	Lounge	1931-1933	Mech.	B. & O.—York	5-hp. motor	1 1	4 7½	Flat belt Belt and gear	Body	Freon	Exide—USL and K. W.	576—864 and 1,000	d. c.	....	....	32	B. c. r.
	3	Comb.	1931-1933	Mech.	B. & O.—York	5-hp. motor	1 1	4 7½	Flat belt Belt and gear	Body	Freon	Exide—USL and K. W.	576—864 and 1,000	d. c.	....	....	32	B. c. r.
	1	Official	1931-1933	Mech.	B. & O.—York	5-hp. motor	1 1	4 7½	Flat belt Belt and gear	Body	Freon	Exide—USL and K. W.	576—864 and 1,000	d. c.	....	....	32	B. c. r.
B. & M.	1	Coach	9-1931	Ice	R. B. Engrg. Co. and B. & M.	None	1	4	Flat belt	Body	Ice	Edison	340	d. c.	....	....	32	B. c. r.
C. & O.	1	Salon-coach	1933	Mech.	P. C. & M. C.	Speed reducer	None	.....	.....	.....	Freon	.....	.....	a. c.	3	60	220-440	.....
	3	Lounge-diner	1933	Mech.	P. C. & M. C.	Speed reducer	None	.....	.....	.....	Freon	.....	.....	a. c.	3	60	220-440	.....
	3	Diners	1932	Mech.	P. C. & M. C.	Speed reducer	None	.....	.....	.....	Freon	.....	.....	a. c.	3	60	220-440	.....
	2	Club diners	1933	Mech.	P. C. & M. C.	Speed reducer	None	.....	.....	.....	Freon	.....	.....	a. c.	3	60	220-440	.....
	3	Salon-coach	1932	Mech.	P. C. & M. C.	Speed reducer	None	.....	.....	.....	Freon	.....	.....	a. c.	3	60	220-440	.....
C. & E. I.	2	Diners	7-1932	Ice	Safety C. H. & L.	None	1	4	Flat belt	Body	Water	Edison	375	d. c.	....	....	32	B. c. r.
C. & N. W.	1	Diner	6-1931	Mech.	Modine-Melcher	4-½ hp. motors	1	5	Flat belt	Body	Methyl-chloride	Exide	450	d. c.	....	....	32	B. c. r.
	4	Diners	5-1932	Mech.	P. C. & M. C.	Speed reducer	None	.....	.....	.....	Freon	.....	.....	a. c.	3	60	220	.....
C. R. I. & P.	4	Diners	6-1932	Ice	A. C. & F.	None	1	4	Flat belt	Body	Water	USL	450	d. c.	....	....	32	B. c. r.
Ill. Central	3	Chair	1932	Mech.	Westinghouse	Motor	1	15	10 gear and 1 V-belt	Truck	Freon	3 Exide	1,000	a. c.	3	60	220	.....
	2	Diners	1932	Mech.	Westinghouse	Motor	1	15		Truck	Freon	1 Edison	1,000	a. c.	3	60	220	.....
	2	Parlor	1932	Mech.	Westinghouse	Motor	1	15		Truck	Freon	3 USL	1,000	a. c.	3	60	220	.....
	2	Lounge	1932	Mech.	Westinghouse	Motor	1	15		Truck	Freon	3 Gould	1,000	a. c.	3	60	220	.....
	2	Comb.	1932	Mech.	Westinghouse	Motor	1	15		Truck	Freon	1 K. W.	1,000	a. c.	3	60	220	.....
M-K-T	3	Diners	5-1931	Mech.	Carrier	Motor	2	1—7½, 40 v. 1—10, 115 v.	Gear	Body	Ammonia	1 Exide 2 Gould	750	a. c.	3	60	220	.....
	2	Lounge	7-1933	St. eject.	Safety C. H. & L.	None	2	5 each	V-belt	Body	Water	Exide	1,000	d. c.	....	....	32	B. c. r.
	1	Business	8-1933	Mech.	Frigidaire	Motor	2	1—15 1— 5	Gear V-belt	Truck Body	Freon	Exide	2,000	a. c.	3	60	220	.....
	2	Lounge	7-1933	Mech.	1 Frigidaire 1 Westinghouse	Motor	2	1—15 1— 5	Gear V-belt	Truck Body	Freon	Gould-USL	2,000	a. c.	3	60	220	.....
Mo. Pac.	3	Diners	5-1933	Mech.	Frigidaire	Motor	1	15	Gear	Truck	Freon	Exide	1,000	a. c.	3	60	220	.....
	2	Lounge	4-1933	St. eject.	Safety C. H. & L.	None	2	5 each	Flat belt	Body	Water	Edison	900	d. c.	....	....	32	B. c. r.
Int. Grt. Nor.	2	Lounge	5-1933	Mech.	Westinghouse	Motor	1	15	Gear	Truck	Freon	Exide	1,000	a. c.	3	60	220	.....
St. L. B. & M.	1	Business	7-1932	Mech.	Modine-Melcher	5 Motors	2	4 each	Flat belt	Body	Methyl-chloride	Edison	900	a. c.	3	60	220	.....
	2	Diners	8-1933	St. eject.	Safety C. H. & L.	None	2	1—4 1—5	Flat belt	Body	Water	Edison	700	d. c.	....	....	32	B. c. r.
	2	Diners	6-1933	Mech.	Frigidaire	Motor	1	15	Gear	Truck	Freon	Exide	1,000	a. c.	3	60	220	.....
N. Y. C.	15	Diners	7-1932	Ice	P. C. & M. C.	None	1	4	Flat Belt	Truck	Ice	USL	450	d. c.	....	....	32	B. c. r.

* Battery charging receptacle only.

Railroad	No. of cars	Type of cars	Date equipped	Type of system	Manufacturer of system	Compressor drive	Generators: No.	Generators: Capacity, kw.	Generators: Type of drive	Generators: Type of mounting	Refrigerant	Storage batteries: Make	Storage batteries: Amp.-hr. capacity	Outside power supply: Current Characteristics: a. c. d. c.	Phase	Cycles	Volts	
N. Y., N. H. & H.	2	Diners	7-1932	Ice	Airtrol-Rails Co.	.....	2	5	Flat belt	Body	Ice	Exide	1,200	d. c.	....	....	32	B. c. r.
	2	Diners	9-1932	Ice	Airtrol-Rails Co.	.....	2	5	Flat belt	Body	Ice	Exide	1,200	d. c.	....	....	32	B. c. r.
	1	Coach	9-1932	Ice	Airtrol-Rails Co.	.....	1	4	Flat belt	Body	Ice	Exide	325	d. c.	....	....	32	B. c. r.
	1	Coach	11-1932	Ice	B. F. Sturtevant Co.	.....	1	4	Flat belt	Body	Ice	Exide	325	d. c.	....	....	32	B. c. r.
	3	Club	8-1932	Ice	Airtrol-Rails Co.	.....	1	4	Flat belt	Body	Ice	1 Exide-2 Willard	325 and 335	d. c.	....	....	32	B. c. r.
	2	Diners	8-1933	Ice	B. F. Sturtevant Co.	.....	2	5	Flat belt	Body	Ice	Exide	1,200	d. c.	....	....	32	B. c. r.
Pennsylvania	1	Diner	6-1931	Ice	P. R. R.	.....	1	4.8	Flat belt	Body	Ice	Lead	600	d. c.	....	....	32	B. c. r.
	4	Diners	8-1931	Ice	P. R. R.	.....	1	4.8	Flat belt	Body	Ice	Lead	600	d. c.	....	....	32	B. c. r.
	5	Diners	1932-33	Mech.	.....	Motor	1	15	Gear	Truck	Freon	Lead	800	....	....	....	.....	.....
	1	Diner	6-1932	Mech.	.....	Motor	1	15	Gear	Truck	Freon	Lead	800	....	....	....	.....	.....
	1	MU-coach	8-1932	Mech.	.....	Motor	Motor driven from 25-cycle traction power supply				Methyl-chloride	.....	.....	....	....	....	.....	.....
	1	Coach	1-1933	Mech.	.....	Motor	1	15	Gear	Truck	Freon	Lead	800	....	....	....	.....	.....
	1	Coach	6-1933	Ice	.....	.....	1	4.8	Flat belt	Body	Ice	Lead	500	d. c.	....	....	32	B. c. r.
	1	Coach	7-1933	St. eject.	.....	.....	1	4.8	Flat belt	Body	Water	Lead	800	d. c.	....	....	32	B. c. r.
	42	Diners	1932-33	Ice	P. R. R.	.....	1	4.8	Flat belt	Body	Ice	Lead	800	d. c.	....	....	32	B. c. r.
	19	Comb.	1933	Ice	P. R. R.	.....	1	4.8	Flat belt	Body	Ice	Lead	500	d. c.	....	....	32	B. c. r.
	1	Diner	7-1933	Mech.	.....	Motor	1	20	Gear	Truck	Freon	Lead	1,000	....	....	....	.....	.....
	83	Coaches	1933	Ice	P. R. R.	.....	1	4.8	Flat belt	Body	Ice	Lead	500	d. c.	....	....	32	B. c. r.
Pullman Co.	92	Sleeping,		Ice	.....	.....	....	....	.....	.....	Ice	.....	.....	....	....	....	....	.....
	61	parlor,		Mech.	P. C. & M. C.	.....	....	....	.....	.....	Freon	.....	.....	....	....	....	....	.....
	86	lounge, lounge-		Mech.	B. & O.—York	.....	....	....	.....	.....	Freon	.....	.....	....	....	....	....	.....
	3	buffet,		Mech.	Frigidaire	.....	....	....	.....	.....	Freon	.....	.....	....	....	....	....	.....
	1	comb. &		St. eject.	Safety C. H. & L.	.....	....	....	.....	.....	Water	.....	.....	....	....	....	....	.....
	1	chair		Water evap.	.....	.....	....	....	.....	.....	Water	.....	.....	....	....	....	....	.....
St. L.-S. F.	6	Cafe-lounge	1933	Ice	Frisco R. R.	.....	2	4	Flat belt	Body	Ice	Lead	800	d. c.	....	....	32	B. c. r
	4	Coaches	1933	Ice	Frisco R. R.	.....	1	3	Flat belt	Body	Ice	Lead	400	d. c.	....	....	32	B. c. r.
	4	Diners	1933	Ice	Frisco R. R.	.....	2	4	Flat belt	Body	Ice	Lead	800	d. c.	....	....	32	B. c. r.
	3	Lounge	1933	Ice	Frisco R. R.	.....	2	4	Flat belt	Body	Ice	Lead	800	d. c.	....	....	32	B. c. r.
Sou. Pac.	14	Diners	1932	Mech.	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	Freon	Edison	450	a. c.	3	50—60	220—440	.....
Tex. & Pac.	3	Lounge	5-1933	St. eject.	Safety C. H. & L.	.....	2	5	Flat belt	Body	Water	Edison	900	d. c.	....	....	32	B. c. r.
	4	Diners	7-1933	St. eject.	Safety C. H. & L.	.....	2	1—4 1—5	Flat belt	Body	Water	Edison	910	d. c.	....	....	32	B. c. r.
Union Pac.	15	Diners	1932	Mech.	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	Freon	Edison and Edison lead	450	a. c.	3	60	220	.....
	3	Diners	1932	St. eject.	Safety C. H. & L.	.....	2	1—4 1—5	Flat belt	Body	Water	Exide	1,000	d. c.	....	....	32	B. c. r.
Wabash	1	Chair	1932	Mech.	A. C. & F.	None	2	1—4 1—10	Flat belt Gear and V-belt	Body	Freon	Exide	1,000	d. c.	....	....	32	B. c. r.
	2	Chair	1932	Ice	Wabash	.....	1	4	Flat belt	Body	Ice	Gould	500	d. c.	....	....	32	B. c. r.
	2	Chair	1933	Ice	Wabash	.....	1	5	Flat belt	Body	Ice	Gould	500	d. c.	....	....	32	B. c. r.
	1	Chair	1933	Ice	Wabash	.....	1	4	Flat belt	Body	Ice	Gould	500	d. c.	....	....	32	B. c. r.

Summary of Types of Systems and Refrigerants Used

Railroad	No. cars	Type of system: Electro-mech.	Direct mech.	Ice	Steam ejector	Refrigerant used: Freon	Water	Ammonia	Methyl-chl.
Alton	16	16	...	...	...	16	...	...	...
A. T. & S. F.	23	1	...	...	22	...	22	1	...
B. & O.	62	62	...	...	...	62	...	...	...
B. & M.	1	...	...	1	...	...	1	...	...
C. & O.	12	...	12	...	...	12	...	...	...
C. & E. I.	2	...	...	2	...	...	2	...	...
C. & N. W.	5	1	4	...	...	4	...	...	1
C. R. I. & P.	4	...	...	4	...	...	4	...	...
Ill. Central	11	11	...	...	...	11	...	...	...
M-K-T	8	6	...	...	2	3	2	3	...
Mo. Pac.	12	8	...	...	4	7	4	...	1
N. Y. C.	15	...	...	15	...	...	15	...	...
N. Y., N. H. & H	11	...	...	11	...	...	11	...	...
Penna.	160	9	...	150	1	8	151	...	1
Pullman	244	89	61	92	2	150	94	...	...
St. L.-S. F.	17	...	...	17	...	...	17	...	...
So. Pac.	14	...	14	...	...	14	...	...	...
T. & P.	7	...	...	...	7	...	7	...	...
Union Pac.	18	...	15	...	3	15	3	...	...
Wabash	6	1	...	5	...	1	5	...	...
TOTAL	648	204	106	297	41	303	338	4	3

Stresses in Welded Structures*

By Everett Chapman†

A discussion of the relation of welded joints to the structure; the value and importance of properly welded joints and some of the results of improper welding

THE science of structures is concerned with the economic distribution of elastic material to connect a load to its reactions over a reasonable length of time. Intimately associated with this broad subject are the various methods used to join the component members of the structure.

Any structure built of pieces must necessarily act as a whole under its applied loads. Joint efficiencies, therefore, determine the action of the structure. As the unit stresses are raised, high joint efficiencies become more and more important. As the loading cycle becomes more and more frequent, homogeneous joints become imperative.

Properly welded joints are more nearly homogeneous than any other type of connection between two pieces of material. Homogeneous joints are eminently desirable since they particularly affect the rigidity and fatigue performance of the structure.

Consider the two methods of supporting a load over a span, as exemplified in Fig. 1. The usual truss and

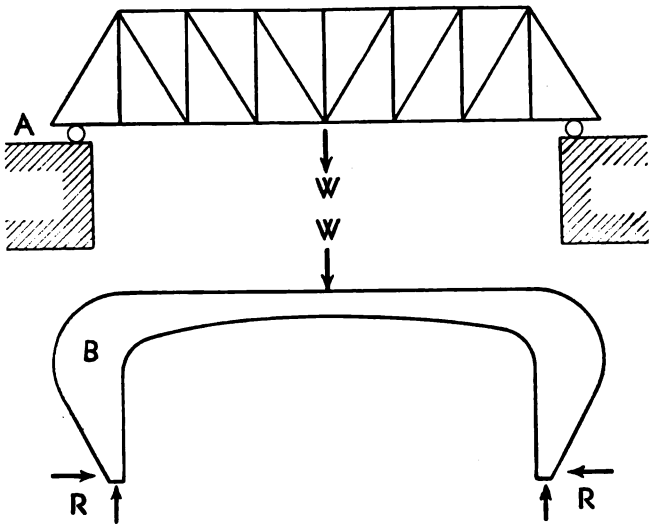


Fig. 1

abutment arrangement is essentially a three-piece structure, connected by pin joints. The rigid frame bridge is a one-piece structure in which the transition from horizontal to vertical members is distinguished by the fact that this apparent joint can transmit bending moments. In the one-piece rigid frame bridge, the bending moments are distributed uniformly over the entire structure. The vertical and horizontal members interact to redistribute the bending moments. When, as in this case, adjacent members interact through a rigid junction, the redistribution of bending moments may effect an economy of material running as high as 30 per cent. Considered broadly, the type of joint at the knee of the one-piece rigid frame bridge is the joint inherent in a properly welded design.

Two plates can be welded together so that the joints, as such, vanish. A homogeneous joint, or transition between two pieces of material, is a joint whose elastic behavior cannot be distinguished from that of the same configuration cut from a single piece of material. In the unattainable ideal, the maximum stress would have the same value as the average stress. The fact that this ideal can be closely approached in welded points has two implications for the structural designer.

First, as has been mentioned, is the fact that continuity can be taken into consideration in the design of gross structures such as bridges and buildings in which the moment of inertia of each member is much less than the corresponding constant for the whole structure. Welded design is eminently adapted to the curvilinear structures which result when continuity of elastic action is considered in the design. The second implication is that the behavior of the properly welded structure, under impact and fatigue load, is similar to that of a jointless structure as far as service life is concerned. The entire structure's resistance to severe loading conditions represents the thoroughly consolidated resistance of its components.

Homogeneous Welded Joints

A homogeneous joint has two characteristics. First, the material comprising the joint must have uniform physical properties from point to point; it must not have been damaged in any respect by the fabricating process. Second, the distribution of stress throughout the joint, from point to point, should be of maximum uniformity.

With a homogeneous joint of the desired characteristics, the two members are joined in such a manner that neither the elastic action nor the plastic action of the composite is distinguishable from the action of a single piece.

Three factors control the two desired characteristics of the homogeneous welded joint.

First, the parent metal is damaged by the extreme heat of the welding operation. Fig. 2 shows the transition zone between weld metal and 0.40 per cent carbon base metal. The large grain size is indicative of the high temperature to which the parent metal has been raised by the heat of the arc. The metallic heat path to the body of cold parent metal forms an excellent thermal sink, and the resulting rapid heat flow away from the weld thoroughly quenches the heated zones around the weld. The net result is a zone of highly overheated and quenched material adjacent to the weld. The severity of damage in this zone is a particular function of the carbon content of the parent metal, or more generally, a function of the air-hardening ability of the steel. This damaged zone, whatever its extent,

* Abstract of paper presented at the annual meeting, American Society of Mechanical Engineers, New York, N. Y., December 6, 1933.

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Fig. 2

represents a discontinuity in physical properties, since the large, overheated grain is decidedly weak in resistance to fatigue and impact. In addition, the hardened micro-constituents, due to the quenching action, are very strong, but they lack the ductility necessary to compensate for the thermal stresses to which the piece is subjected in the welding operation. The joint may crack through the damaged zones during fabrication. This phenomenon may be carried over into the service behavior of the structure if the damage is not corrected.

Second of the factors controlling the production of homogeneous welded joints is the design of the joint itself. It is the rule rather than the exception that stress concentrations of a very severe nature may exist in the joint. Fig. 3 shows the heterogeneous stress

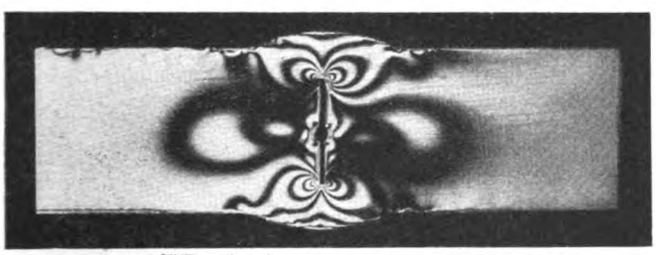


Fig. 3

condition which exists in an improperly designed welded joint. This photo-elastic study represents a loaded butt joint between two pieces of metal of equal thickness. The two welds, deposited from each side, did not meet at the center. The unfused portion forms an internal boundary which produces an extreme variation in stress over the joint. At the end of this crack, the stresses are very high. In addition, intermediate high stresses exist at the ends of the reinforcements which are usually, and vainly, applied in order to strengthen this type of joint. Such reinforcements are effective only under static load. But under impact or fatigue loads, the changes in contour at the ends of the reinforcements introduce additional stress maximums.

Third of the factors influencing the production of homogeneous welded joints is the element of residual stress introduced in the structure through contraction of cooling weld metal. Little is known of the direction or magnitude of these thermal stresses. However, there is direct evidence that the residual stresses, in many cases, may exceed the yield point of low carbon steel. When a known service load is superimposed on a structure which is already loaded by residual stresses in an indeterminate manner, the elastic conditions which exist from point to point are highly chaotic. In addition to the elastic chaos that residual strains may produce in a welded structure, severe warping will occur when the strains are relieved, either in the machining operation or by a gradual creep over a period of time.

Results of Improper Welds

Fig. 4 represents graphically the abortion which can result from the improper execution of a welded joint. This joint is far from homogeneous. The physical

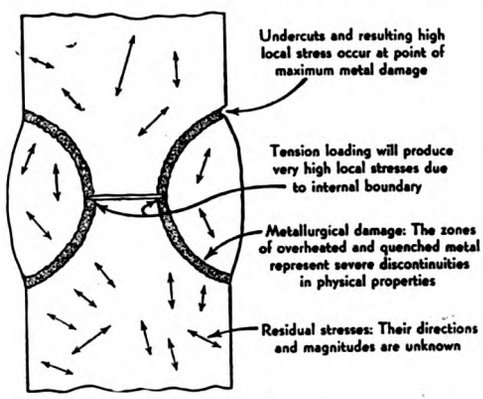


Fig. 4

properties are not uniform from point to point, since there are zones of badly damaged metal. The stress values throughout the joint, when loaded, vary tremendously from point to point, because, in addition to the stress concentrations which exist at internal and external boundary discontinuities, the unknown residual stresses add to the concentrated load stresses, and thus produce utter chaos.

Whenever a welded joint, whatever its type, functions in a non-homogeneous manner, one or more of three destructive factors are operating—sharp changes in contour, damaged material, and pre-loading. For

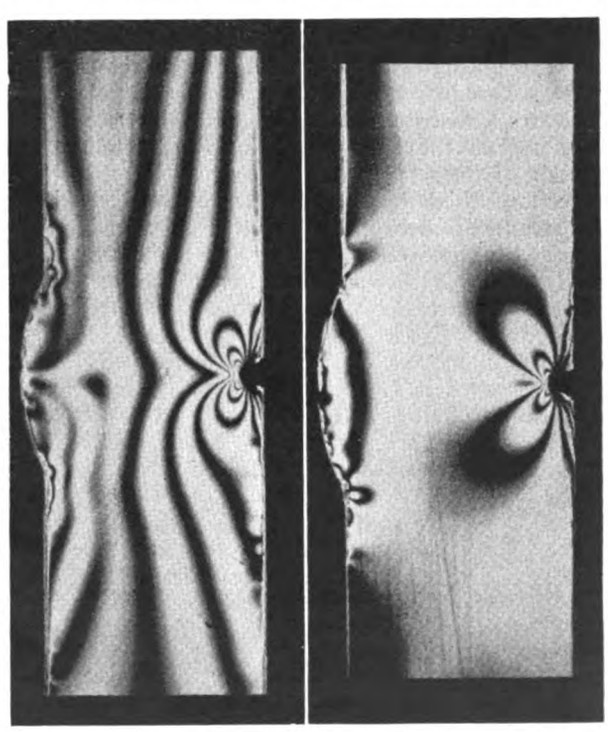


Fig. 5

example, Fig. 5 represents a stress distribution usually found in a weld made from one side of a plate. Such welds frequently introduce ragged contours, since the form of penetration of the weld metal cannot be completely controlled from one side. Where the design of the structure is such that welding from both sides is impractical, the use of backing-up strips permits the production of a compromise contour which is at least predictable.

Fig. 6 shows a failure resulting from a slovenly job of welding. The fatigue crack centered about the stress concentration produced by an extraneous bit of weld metal carelessly left by the welder to project from an important boundary of the structure.

Correction of the destructive factors which are present

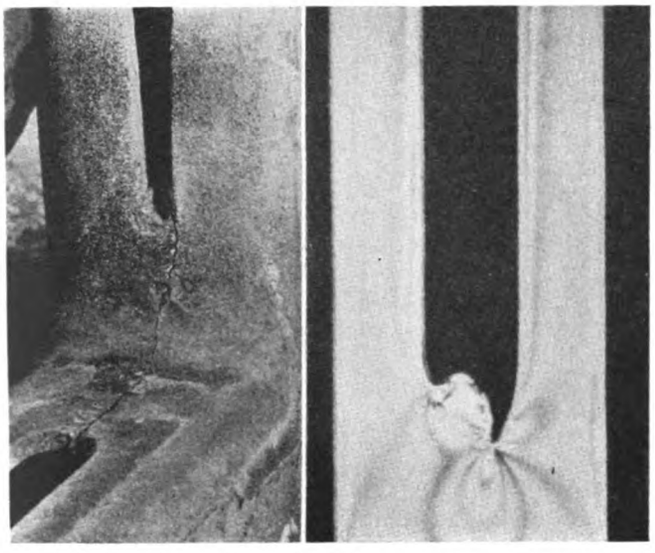


Fig. 6

in non-homogeneous joints simply revolves around two elements, first, the drafting room practice, and second, heat treatment.

As it is concerned with the design of the joints, drafting room practice must be carefully supervised to insure that no defects are allowed to creep into the structure. Design practice can no more afford to neglect the stress distribution in the joint than it can afford to neglect the stress distribution throughout the gross body of the structure.

Correction of damage to parent metal necessitates a heat treatment after the structure has been welded. The series of photo-micrographs, Fig. 7, illustrates the effect of welding, stress-relief, and treatment at the two critical temperatures, of two pieces of steel of different carbon content. All the photographs in Fig. 11 were made at 100 diameters, and etched with nital. The first picture represents the as-rolled condition of 2-inch plates. All the other pictures were taken on the very edge of the weld metal and illustrate the effects which occur in the parent metal. In the as-welded condition, it is seen that the parent metal in the case of 0.40 carbon steel is in a martensitic condition, while the 0.24 carbon steel shows evidence of the original austenite with troostite forming at the grain boundaries. It is to be noted also that the grain has been enlarged considerably. The probable characteristics of these two zones are extreme brittleness, no ductility and a general weakened condition due to the large grains. With such characteristics, these zones cannot absorb any energy, as they would be called upon to do in the case of an impact, and, furthermore, they have no self-relieving properties under thermal stresses because of their lack of ductility.

The effects of the usual stress-relieving treatment at 1,200 deg. F., followed by a furnace cool, are illustrated in the third group of two pictures. The temperature 1,200 deg. F., is usually considered sufficient for stress-relief, since at this temperature, ordinary low carbon steels have a yield of only about 2,000 lb. per sq. in. This means, of course, that any residual stress greater than 2,000 lb. per sq. in. will produce plastic deformation, and will therefore, vanish for all practical purposes. The pre-loading which was introduced by the contracting weld metal has been removed. However, 1,200 deg. F., if held for a proper length of time, will serve to break down the harder micro-constituents which are formed in the damaged zones. It will not, however, refine the grain, since the carbon does not go back into solution at this temperature.

It is also to be noted, then, in the third group of two pictures delineating the 1,200 deg., F. treatment, that the martensitic and troostitic phases in the two steels have been broken down to what is probably a finely divided sorbite and it is reasonable to suppose that the residual stresses after this treatment are under 2,000 lb. per sq. in.

Experience indicates that welded structures which have received this treatment will retain their shape during machining and indefinitely thereafter. Treatment at 1,350 deg. F. partially refines the grain, while the treatment at 1,650 deg. F., followed by cooling in still air, represents the maximum degree of refinement that can be obtained. Furnace cooling from 1,650 deg. F. is rarely practical since light-weight, high-duty structures may suffer severe distortion in the furnace due to their

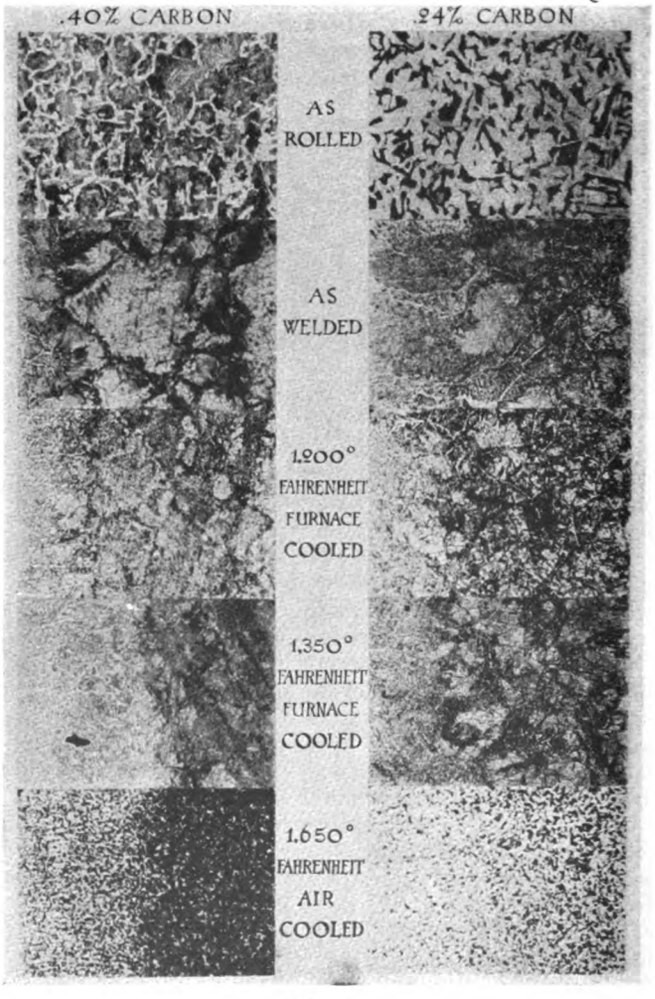


Fig. 7

own weight. The practical compromise that represents the best commercial practice is, therefore, a soaking treatment for one hour per inch of maximum thickness at 1,200 deg. F., followed by a slow furnace cooling. Under more rigorous service conditions a gain can practically be effected by raising the temperature to 1,400 deg. F., at which temperature the grain undergoes partial refinement.

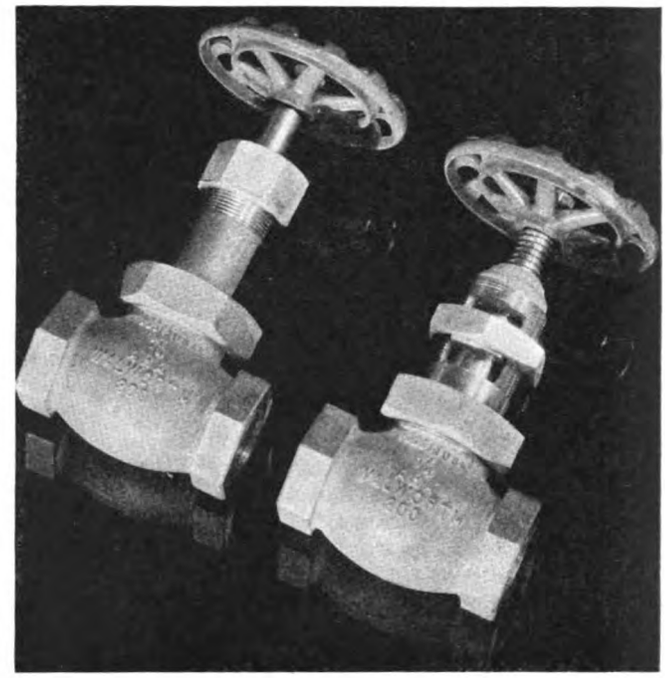
The importance of keeping the carbon content of the steel in the lower ranges is graphically represented in the series of micro-photographs. The local damage done to the higher carbon materials more than offsets the higher average properties which they represent. It is through specifications of carbon content that the welding of large structures such as bridges and ships, which cannot be annealed in a furnace, will become practical. However, even where metallurgical damage has been minimized in this manner, the problem of stress relief is not solved. As more is known of the nature of residual stresses, mechanical peening will offer a compromise solution which will enable the full possibilities of welded construction to be realized by the designer. The carefully executed ideal, in which contours have received proper attention and which has been properly heat treated, need have a lower factor of safety than any other type of construction: it is more predictable. As the service duties increase and more and more is demanded of the available structural materials, the factor of safety must be reduced. Modern transportation trends are imposing high duties on available structural materials. Careful design and selection of materials are the only path to uniform stress, one piece structures. In such structures, the joint as an entity must vanish. The behavior of a properly made welded joint under any kind of load or load cycle cannot be distinguished from a single piece of rolled steel.

Walworth Builds A.R.A. Standard Valves

IN 1932 the American Railway Association, Mechanical Division, adopted specifications for standard globe and angle valves for steam locomotive service for 300 lb. pressure making the recommendations effective August 1, 1933. The purpose of the standard valve is to insure absolute interchangeability of parts regardless of the valve company producing the valve. The illustration shows such a standard valve as manufactured by the Walworth Company, New York, which is now producing the 1¼-in. size. Other sizes will be in production in the near future.

The specifications call for the manufacture of the body of steam bronze; the bonnet, bonnet ring, stuffing nut and disc nut of steam bronze or forged brass; the inside-screw stem of rolled brass rod or forged brass; the outside-screw stem of stainless steel; the seat ring and disc of copper-nickel alloy having a Brinnell hardness of not less than 100; the gland and handwheel-nut of free-cutting brass rod or forged brass and the handwheel of malleable iron. The standards adopted include the material specifications, globe and angle valve assembly, dimensions for inside and outside screws, union ends, markings and the details of every part.

The valve body, either globe or angle, fits the inside-screw or outside-screw yoke bonnet; that is, if it is desired to change a valve in service, from one type to the other it can be done without removing the valve from the line. Likewise, if it is desired to change the discs and seats from the regular type to the plug type, this can be done. The plug type discs are generally used on throttling service.



Two types of A. R. A. standard globe valves manufactured by the Walworth Co.

The principal features of the A. R. A. standard valve are interchangeability, due to close tolerances of manufacture, oversized stems and generally rugged construction.

"CITY SLICKERS" MAKE A SALE.—Three suave gentlemen who probably got their start in life by selling the Brooklyn bridge and the New York post office to gullible visitors from the country put in a good day's work recently at Denison, Tex. They sold the Denison station of the Missouri-Kansas-Texas to an unsuspecting citizen of Waco, Tex. For the station and "one-third of the proceeds from the sale of tickets to the Century of Progress in Chicago," the victim paid $1,100.

* * *



A 45-ton, 170-hp. gas-electric locomotive built by the Atlas Car & Manufacturing Company, Cleveland, Ohio, for service at the U. S. Navy airship station at Sunnyvale, Cal.

EDITORIALS

Supervision Challenged

"Too often," writes a correspondent, "bad conditions in handling traffic are charged to the men, when as a matter of fact the supervisor is the one at fault. It has been my experience that ninety-nine per cent of the men under my jurisdiction will do the work as I wish it to be done; in order to realize my wishes, however, I must get in personal contact with the individual who may be at fault."

If this is true, then successful supervision depends largely upon the ability of the supervisor to educate and properly train the men under him. He must not only know how the job should be done, but even more important than this, he must be able to teach and train the worker exactly how to do it. How much consideration has been given to teaching ability in selecting supervisors, or how thoroughly do the supervisors understand the importance of approaching their problem in this attitude?

New kinds of equipment are being introduced on the railways, the proper care and maintenance of which will require a thorough knowledge and understanding of its construction and operation. It may be necessary to work to closer tolerances than on the older types of equipment, or the design of the parts may be such as to require new and improved practices and facilities for their care and maintenance. Obviously, under these conditions the supervisors and the workers must put forth special efforts to equip themselves for handling the new facilities, if they are to make good on the job.

To complicate conditions still further, the working forces have been greatly reduced and more or less disorganized under the stress of economic conditions. Apprentice instruction in some instances has been neglected, if, indeed, any apprentices are still on the job. It is significant that under normal conditions the younger men, trained under modern apprenticeship methods, have in many instances made exceptionally good records because their training fitted them to take care of new equipment or meet new conditions, to which the older men with their more limited training could not adapt themselves.

Mechanical department officers are now faced with the problem of rehabilitating their organizations and getting ready for an amount of business in 1934 which promises to surpass considerably that of the past two years—the trend, at least, is strongly in that direction at this time. This will undoubtedly place a heavy load upon the shoulders of the supervision. The supervisor must study hard to keep ahead of the game, so that he can thoroughly and properly train the men under his direction, and at the same time must occupy himself with the difficult task of rebuilding his organization.

Incidentally, that railroading is worth while and that it still possesses a certain amount of romance and challenge, is indicated by the following quotation taken from a letter written by the chief executive of a large railroad to a young man who was desirous of securing information about the possibilities in the railroad field. "It is difficult," said the chief executive, "to conceive of any development that might come in a lifetime that would render railroads materially less essential than they are now to the economic life of the nation. It naturally follows that there will continue to be railway work to do. . . . The railroads have completed the task of pushing out the frontiers of American civilization, but there are new tasks in the refinement of the art, the development of new methods and devices, which offer a stirring challenge to the men of pioneering spirit."

Here, at least, is an encouraging note which should be a real inspiration to the officers and supervisors charged with rebuilding their organizations under present conditions. The emphasis, however, upon "new tasks in the refinement of the art, the development of new methods and devices," must not be overlooked. The success of the railroads will depend to a very great extent upon the ability of the executives and supervision to meet these new demands, which are far more complicated, although possibly less spectacular, than those with which they have been confronted in the past.

Air Conditioning Is Established

Competition in passenger business, keen at any time and particularly so during the past five years, has forced the railroads of the United States to develop many improvements in services in an effort to win back some of the lost traffic. There were those who were skeptical, when air conditioning was first suggested as a means of increasing passenger comfort, as to the advisability of such a program under existing economic conditions. The results of over three years of development by the railroads and the manufacturers of air-conditioning equipment have more than justified the efforts of those who pioneered in this work. Where three years ago air conditioning was in the experimental stages, today it is an established part of the equipment on many of the finest trains in the country.

Some idea of the progress that has been made in this field may be had from the statistical data concerning air-conditioned passenger cars which appear on pages 48 and 49 of this issue. It will be seen that during the past three years 21 roads have equipped 404 cars in addition to 244 cars equipped by the Pullman Company, making a total of 648 air-conditioned cars in the United States on December 31, 1933. It is a coincidence that there is an almost equal division with reference to types of systems between the mechanical systems—either direct or electro-mechanical—and those using ice; 310 cars being equipped with the former and 297 cars with the latter systems. Of the 310 cars equipped with mechanical systems 303 use Freon as a refrigerant, four use ammonia and three use methyl-chloride.

One of the really encouraging things about this development in a new field is that it was carried out during years when expenditures for railroad equipment and improvements were being held to those items which might be classed as absolute operating necessities, and apparently, having had to force its way through such economic handicaps, it now bids for a very definite place

in the railway equipment field. Within the past two months, and particularly since the first of this year, there has been a great deal of activity in air conditioning. Already announcement has been made of programs for equipping 634 cars—almost as many as in the past three years—and unconfirmed reports indicate the possibility of between 400 and 500 more cars being added to this list.

The question of whether or not the railroads are to make extensive use of air conditioning has been answered. The problem from now on is one of establishing the best practices for operation and maintenance.

Rehabilitation Begins

After eleven months devoted to the development of political measures for hastening national industrial and commercial recovery, results which first began to appear in the railway field in December have gathered headway during January. Orders have now been placed for 30 steam locomotives, over 19,700 freight cars and 159 passenger cars, which represent the major portion of the equipment to be financed out of the allocation of more than $200,000,000 which has been made for the railroads from the $3,300,000,000 fund at the disposal of the Public Works Administration. These orders, and orders for rail for which over $50,000,000 has been set aside, probably mark the largest single effort toward "priming" the capital goods industry which has been made since the administration at Washington gave evidence that it was aware of the importance of these industries to the success of its plans for effecting recovery by artificial stimulation. Both the freight- and passenger-car orders are the largest placed in any year since 1930. They amount to about 1,100 more freight cars and nearly two times more passenger cars than were ordered during the past three years.

In addition to the new equipment which is being purchased, arrangements are also under way for the repairing and rebuilding of over 1,000 locomotives, about 30,000 freight cars and over 1,100 passenger cars, to be financed from the $200,000,000 allotment to the railroads.

These measures set the stage for industrial and commercial activity which will feed more than $200,000,000 through channels which will direct it into the hands of thousands of men who would otherwise remain unemployed, perhaps for months to come. These men in turn will spend their newly acquired incomes for the discharge of debt, for rent, food, clothing, services and some luxuries, which will broaden the base of the demand for the products of many industries.

The amount involved is too small by itself to effect a permanent return of prosperity to the builders of railway equipment and the manufacturers of materials purchased by the railways. Coming at the beginning of the second year during which the forces of recovery have outweighed those tending to prolong and deepen the depression, however, there is good reason to believe that they mark the beginning of a healthy demand which will be felt for many months to come. Indeed, one railroad has already ordered 18 passenger cars, to be financed on its own credit, in addition to those which are to be financed from P. W. A. funds.

It is a significant fact that the total number of locomotives on the lines of the Class I railways do not exceed the number which were in active service at times during 1928 and 1929. The number in serviceable condition during the latter part of 1933 was about equal to the number in active service during the first half of 1931.

From April to October, 1933, the monthly road-locomotive miles increased from 60,000,000 to 70,000,000. A further increase of about 12,000,000 would restore locomotive mileage to the early 1931 basis, when all the locomotives now serviceable would be busy and any reserve would have to come from the accumulation awaiting repairs. Such an increase in business, restoring weekly car loadings to well toward 800,000, which may very readily take place during the present calendar year, will require an increase in maintenance activities which will tax railway equipment repair facilities. Equipment repairs have been falling behind steadily for the past four years, bringing the time constantly nearer at hand when railway operations, even on the present low level, can scarcely be maintained without an increase of maintenance activity, and to this will be added the load of deferred repairs on all classes of equipment, amounting to upwards of half a billion dollars, which will have to be caught up rapidly if increasing traffic is to be handled successfully.

Following the return of the railroads to private operation by the United States Railroad Administration in 1920, the railroads faced an equipment situation comparable with that with which they will have to deal during 1934. In order to meet the upturn of business which followed the depression and shopmen's strike of 1921 and 1922, they found it necessary not only to employ their own shop facilities to their utmost capacity, but also to place a large amount of equipment in the plants of the builders and other contractors for repairs and rebuilding. Whatever justification there may have been for following this policy, few railroad men would wish to repeat it in the light of that experience. The best way for the railroads to utilize the builders' facilities is for the production of new cars and locomotives which at the present time can be used to save a portion of the half billion dollars of deferred maintenance and to reduce the normal maintenance expenditures for at least three or four years. The economics of replacement vs. heavy expenditures for deferred maintenance should be given careful study before formulating complete rehabilitation programs.

Smoke Is Unnecessary

It is impossible to estimate the damage which is done to the health of people living in towns and cities by smoke and gases which pollute the air. It would be difficult, also, to estimate what it means, even roughly, in damage to buildings and their furnishings, and the costs of cleaning the furnishings and also the clothes we wear. It is likewise impossible to estimate the effect of dirty and dingy surroundings upon the mental attitudes and happiness of people who must live a large part of their lives in congested industrial and commercial centers.

The communities in New Jersey, across the river from New York City, contain a large number of industries and railroad terminals, and the entire metropolitan section was affected by smoke from these sources, depending upon the direction of the wind. Three years ago the

authorities in Hudson county, N. J., established a department of smoke regulation, Stevens Institute of Technology at Hoboken, co-operating in the establishment of this department. The results which have been secured in the past three years are really remarkable and should be an inspiration to all those who are interested in the elimination of the smoke nuisance. Smoke Abatement Engineer William G. Christy, in his recent annual report, estimates a reduction of 90 per cent in smoke violations on all classes of fuel burners, equivalent to about 85 per cent actual reduction in smoke density over the three-year period.

One reason why it has been possible to make this record is the fact that the elimination of smoke is evidence of good combustion and correspondingly lower fuel costs, and earnest efforts have been made to educate the public to this truth. Of special interest to railroaders is the fact that of 10,388 stack readings of locomotives operating in Hudson county during 1933, only 330 violations were noted. "Using the standard Ringelmann chart as the basis for measuring smoke," said Mr. Christy, "the railroad smoke density averaged 3.45 per cent for the year 1933, a reduction of 86 per cent since the smoke department began to function in may, 1931."

This report, reaching us just as we were going to press, is of special interest at this time because of the interview, entitled, The Locomotive Smoke Nuisance, which will be found elsewhere in this issue.

Cross-Counterbalancing

On another page in this issue will be found an article dealing with cross-counterbalancing which is a paper presented by Lawford H. Fry at a session of the Railroad Division during the annual meeting of the American Society of Mechanical Engineers last December. In two respects this paper goes farther in mathematical exactitude than it has generally been considered necessary in practice, first, in the analysis of the weight and location of the revolving parts to be balanced, and, second, in the correct location of the final counterbalance, including the weight to be added for reciprocating balance. The author's analysis shows that a lack of exactitude in both of these respects may appreciably change the result when the maximum rail and axle loads from the sum of static weight and dynamic augment must be kept within close limits.

With the increasing attention which is being given to high speeds and the already well established need for relatively high-speed operation of locomotives with heavy axle loadings, the need for close control of the maximum axle and rail loadings caused by the dynamic augment from the overbalance requires close attention to the details of counterbalancing. The refinements which Mr. Fry points out add little to the complications of the calculations for crossbalancing and require only the location of the center of gravity of the eccentric crank in addition to the weight which is required in any counterbalancing calculation. The results clearly justify the additional refinements.

In next month's issue will appear the second part of Mr. Fry's paper in which will be found a complete set of calculations arranged systematically in the form of a work sheet for a complete cross-counterbalancing analysis.

NEW BOOKS

MECHANICAL WORLD YEAR BOOK. *Published by Emmott & Co., Ltd., 31, King Street West, Manchester, 3, England. 362 pages, 4½ in. by 6½ in. Price, 1/6 net.*

The 1934 edition of the Mechanical World Year Book includes a comprehensive and up-to-date section on metals and alloys and, in general, metallurgical matters as they concern engineers. The section is illustrated by photo-micrographs and explanatory sketches. Another new section provides data and information invaluable to machine-tool users and machine-tool makers alike. A third new section deals with sheet-metal press work.

ARC WELDING HANDBOOK. *By C. J. Holslag, chief engineer, Electric Arc Cutting & Welding Company, 152 Jeliff Avenue, Newark, N. J. 275 pages, 5 in. by 7½ in., illustrated. Bound in cloth. Price, $1.50.*

This is the seventh edition of the book, first published in 1918. It has been brought up to date with chapters on shielded-arc welding, annealing and new types of electrodes. An explanation has also been added of fusion in the form of a new theory of why steel and other metals hold together. The book has been reprinted in Spanish, French, Japanese and English, in the latter because American idioms and technical nomenclature are inapplicable in the United Kingdom.

AIR CONDITIONING. *By James A. Moyer, state director of university extension in Massachusetts, and Raymond U. Fitts, assistant professor of mechanical engineering, Tufts College. 390 pages, 6 in. by 9 in., illustrated. Published by the McGraw-Hill Book Company, Inc., New York. Price, $4.*

The book deals specifically with air-conditioning principles, ventilation requirements, air filtration, cooling methods, refrigeration for air conditioning, properties of refrigerators, types of equipment, temperature and humidity control, design of systems and auxiliary applications. Railroad passenger cars, office buildings and factories are among the practical applications discussed. While the chapter on railroad passenger cars does not furnish new or precise information to the railroad man who has followed this development during the past two years, the book should be of value to one who wishes to acquaint himself with the underlying principles and the ramifications of air conditioning.

COST AND PRODUCTION HANDBOOK. *L. P. Alford, editor. Published by the Ronald Press Company, New York. 1,544 pages. 5 in. by 7½ in. Bound in imitation leather. Price, $7.50.*

The material in this book is the product of eighty contributing and consulting editors, assembled and arranged under the direction of L. P. Alford. The contributors were chosen because of their practical and authoritative connection with some phase of cost accounting, industrial management or production engineering. The text is divided into 28 sections or chapters, beginning with a general study of business and production statements and reports and continuing through the entire range of the production problems involved in industrial management. Within this category are included sections dealing with machinery, small tools and labor, as well as those dealing with the routine phases of industrial management. Several sections are devoted to various phases of costs and cost accounting. Others deal with the principles of industrial management, operating charts and symbols and classifications. The information in each section is systematically broken down and arranged under numerous sub-headings, and there is an index of 45 pages.

THE READER'S PAGE

Heating 18-Car Trains—A Correction

In a letter appearing on page 18 of the January issue entitled "Heating 18-Car Trains" the formula given should have been shown as follows: $S=N^{(4.31-N/12.5)}$ wherein the value in parentheses is the exponent of N.—EDITOR.

Dave and Alec Called on the Carpet

TO THE EDITOR:

In the January issue of the *Railway Mechanical Engineer* there appears on pages 20, 21 and 22, under the heading "With the Car Foreman and Inspectors," a fool and jester article "Alec and Dave Are Back Again."

This tommyrot from the author of "Alec and Dave" has taken up space in your valuable publication which might have been better utilized. There is nothing educational or inspiring to be gained by reading it.

I am wondering if the author made any attempt to find out how far the argument between Alec and Dave differs from the established method of interchanging cars under A. R. A. rules. If he does not know the rules, he should ask any up-to-the-minute car inspector who will inform him the rules governing the interchange of cars thoroughly covers the very case he has used as the basis of his story.

The fact that cars are interchanged in a business-like manner under A. R. A. rules, particularly Rule 2, throughout the entire country—United States, Canada and Mexico—has entirely wiped out characters of the Alec and Dave type, if indeed they ever existed.

To think that a car inspector would pull a loaded car out of a train for a supposed loose wheel, the only indication being a spattering of oil on the axle at the wheel seat which was caused by a drip leaking from the contents through a crack or seam in the car floor is absurd and to mention it is an unjust attempt to reflect on the intelligence of the car inspectors of American railroads who are governed in cases of this kind by A. R. A. Rules 2 and 61 and paragraphs 116, 140, 142, 218 and 240 of the Wheel and Axle Manual.

There are cases where at the inside of the hub of the wheel an incrusted accumulation of oil and road dust is in evidence which may be taken as a condition indicating some imperfection in the wheel and axle fit, but not necessarily a loose wheel. (See A. R. A. 81.)

The inspector, however, uses his best judgment if a doubt exists as to the safety of allowing a wheel in this condition to remain in service. He does not return the car to the delivering line, as the author of Alec and Dave tells us, but instead he accepts the car, cards it to his shop and repair track for change of wheels in accordance with A. R. A. Rules of Interchange. This work is usually done with little or no delay of the car to the consignee.

There is no room for the Alec and Dave methods under A. R. A. rules which have been adopted after much thought and study of all subjects pertaining to car interchange. The mechanical officers of our railroads may justly take pride in accepting a code of workable rules which are understood and carried out intelligently by car inspectors in discharge of their duties, despite the fact that the author of Alec and Dave has attemped to class them as morons.

A CAR INSPECTOR.

Painting and Repairing Aluminum Cars

A reader asked two questions concerning maintenance practices on aluminum cars which are of sufficiently general interest to publish, together with answers which were supplied by the Development Division of the Aluminum Company of America.

Q.—What primer can be used on the interior aluminum surfaces of passenger cars that will adhere to the metal from eight to ten years as does the primer now in use for similar steel surfaces? A.—It is not so much the priming coat of paint as the preparation of the surface that will make the priming coat stick to aluminum surfaces. The surfaces on either the inside or the outside of the cars should be roughed up either by sandblast or wire wool so that crevices or holes of minute size are left on the surface in which the paint can anchor itself. All oil or grease should be removed by washing with a high volatile solvent, such as naphtha, and the priming coat applied as soon after the preparation of the surface as possible. The priming coat may be sprayed or brushed. A preferred primer for aluminum is one having inherent inhibitive qualities such as would be obtained by zinc or lead chromate. This tends to prevent the undermining of the paint film. It is also desirable that the paint have sufficient flexibility to stand a certain amount of weaving of the surface and that care be taken to see that it dries without cracking; in other words, that a continuous film is provided. There are a number of good primers on the market, such as zinc chromate, that should be good for ten years life if the surface is properly prepared. There are also some bakelites which, used as a vehicle and having zinc chromate and other solids mixed therein, will make an excellent aluminum primer.

Q.—What is the best method of repairing a hole in the roof of an aluminum car? A.—The best way is to apply a small patch over the hole and weld it with an electric metallic arc around the edge to make it tight. If welding equipment is not available, the patch can be applied with drive screws. In the latter case it is desirable to have a thin piece of tar paper, approximately $\frac{1}{32}$ in. thick, between the patch and the roof sheet. In either case both the roof and the patch should be painted before assembly.

ENGINEMAN OF ROYAL SCOT HONORED.—William Gilbertson who will be remembered as the engineman in charge of the Royal Scot during its visit to the Century of Progress in Chicago last summer, was honored by King George on New Year's Day. He was awarded the medal of the Order of the British Empire for having piloted his train without accident over more than 11,000 miles of railway in the United States and Canada.

With the Car Foremen and Inspectors

Split and Cotter Keys

*By P. P. Barthelemy**

AN article entitled "Split and Cotter Keys" by the writer was published in the January, 1933, number of *Railway Mechanical Engineer*. With the advent of severely cold-weather conditions in a large part of this country and in Canada, the seasonal brake-rigging troubles, always at their worst in cold weather, are again with us. These failures are a constant source of operating trouble and car maintenance expense, and further comments on split and cotter-key troubles are again in order.

The accompanying pictures illustrate forcefully conditions that exist on a large number of freight cars. The split and cotter keys shown were removed chiefly from brake-hanger pins on a wide assortment of freight cars of both railroad and private-line ownership. They were in the general defective condition illustrated, except that in some cases some slight distortion from the in-place shape occurred in the removal. From their worn condition, there can be no doubt that they had been defective for a long time and in that condition had passed many inspection points. In several cases, there was evidence that the car had been on a repair track and had been permitted to leave without this bad condition having been corrected.

Of the three illustrations at the bottom of this page the one at the left shows cotters; the center, split keys with one wing worn off just below the eye or head and the other wing also badly worn; the illustration at the right shows a representative lot of defective cotter keys.

Practically all of these defective keys are very old, indicating neglect in renewal attention, and in too many cases the re-use of a key that had obviously already outlived its safe usefulness. Reclaiming old and worn split and cotter keys is very doubtful economy, as the time devoted to reshaping, in most instances, exceeds the very small cost of a new key; but what is by far of greater importance, each of these old worn and brittle keys re-used constitutes a potential failure and probable train accident.

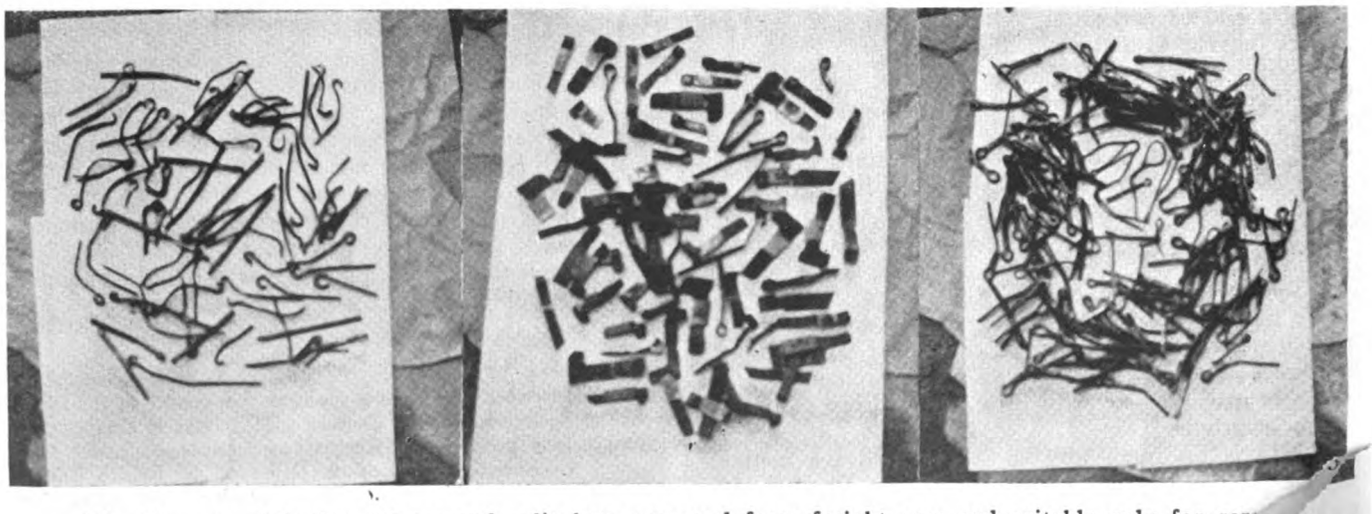
Another bad condition revealed in these pictures is the absence of a standard, resulting in the wide use of keys much too small for the pin hole and too small to provide the degree of security demanded. The length also varies, some of them being over 5 in. long. Over-length keys constitute a hazard in that in the rotation of the pin, the ends of the key may strike an obstruction in the hanger bracket and become straightened and the key lost. Some of the keys are very small; and in one case a short cotter was used through the eye of the main cotter to prevent the head dropping through the hole in the pin. No doubt many others of these small keys dropped through after very little wear and were lost. Some of the samples in these pictures were actually pulled through the pin hole. Occasionally we see even an example of the good old hay wire.

The flat split keys show an equally deplorable condition—neglect, re-use of old and obviously worn-out keys, use of keys made of very thin material, and, in some instances, keys made of scrap thin galvanized iron. Some of these conditions may, of course, be due to deferred maintenance, but in entirely too many instances, there is evidence of inattention and gross carelessness on the part of car owners, both railroad and private lines.

Good Split- and Cotter-Key Practice

There are a few important points that should be observed in connection with split and cotter-key applications, such as having holes in pins large enough to permit the use of keys of substantial size, and always using a key that practically fills the hole in the pin. Spread both wings, each about 45 deg. Re-use only keys

*Assistant master car builder, Great Northern.



Miscellaneous defective cotters and split keys removed from freight cars and suitable only for scr[illegible] ap

of proper size and in obviously first-class condition. Avoid the use of over-length keys. Loop brake hangers, that is, hangers without pins and cotters, should be used wherever possible. Open-type hangers should not be used on new cars nor with new truck side frames. Where the truck construction does not admit the use of the closed loop hanger, other means should be devised for protecting the keys and pins from excessive wear or loss.

Much of our brake rigging trouble is due to vibration rattle. Repairing these defects in so far as the renewal of rattle-worn parts is concerned takes on the nature of a locally-applied remedy and is, therefore, only of a temporary character. Obviously, rattle and vibration that will cause a cotter key to wear thin and a pin to wear half through are also harmful to other parts of the car, those of the truck in particular. It is, therefore, important to trace and locate the causes of these rattle conditions and see if we cannot do something about them. The conventional truck foundation brake arrangement is, for good reasons, hung from the truck frame, which is unprotected by springs. Therefore, all irregularities as between the wheel and rail are transmitted uncushioned through the truck frame to the brake hanger arrangement.

Some of the brake-rigging rattle wear is, of course, caused by vibrations of the shoe, particularly on the upgoing side of the wheel, but since the period of brake application is comparatively short and such applications are not ordinarily frequent, this accounts for only a small part of the wear. Rail joints and other irregularities in the track, and the unresilient road bed in very cold weather, will account for another measure of wear. Ordinary observation, however, discloses the fact that the condition of the wheels has more to do with excessive rattle than any other part of the car. Comby treads, flat spots, shell-outs, worn-through chill, worn out of round, are the chief wheel service conditions that cause pounding. Grinding out flat spots, except by grinding down the entire circumference of the wheel, is also bad as while it eliminates the sharp blow struck by the flat there nevertheless remains the low spot which causes a pronounced pounding harmful at any but very low speeds.

Comments on Wheel Defects, Grinding, Truck Springs, etc.

The pounding defect limit for freight-car wheels is, and for a great number of years has been, based roughly on the 2½-in. flat spot. The weight carried on the wheel has been greatly increased since the adoption of the basic 2½-in. spot. The wheel manufacturers, however, have kept pace with these advances so that the present wheel, with its greatly increased load, is even safer from failure with a limit flat spot than was the one in use when this limit was adopted, a high tribute to the progressiveness of the wheel manufacturers and the A. R. A. Car Wheel Committee. But we are equally concerned with the effect of these defects on the rest of the car, including the brake rigging, and on the lading.

The most important of all recent developments is the great increase in freight-train speeds. Certainly, cars having wheels with near-limit tread defects are not safe to handle in trains operating at some of the present high speeds. Should there not be a downward readjustment in the basic limits for tread defects on freight-car wheels? Would it not be a paying practice to grind the chilled-iron wheel to a perfectly true contour after mounting? Slight eccentricities in mounting and irregularities in tread surface would be removed, and it is reasonable also to expect such wheels to run longer before developing tread defects, and they would run even more smoothly than a turned steel wheel.

Are we not literally squandering money by trying to get every penny's worth of service out of our wheels at the expense of other parts of the car? The line indicating the development of tread-wear defects is not a straight one, but a curve that starts out slowly from the straight line and increases in sharpness of curvature as the defect wear progresses, being very rapid in the last stages. In other words, a comby or chill-worn wheel, for example, with defect to, say, 75 per cent of the condemning limit, has comparatively little mileage left in it since at that stage these defects increase very rapidly. The net service cost of the chilled-iron wheel per 1,000 miles is very low.

The effect of rattle and pound is indicated by excessive wear on the bolster and guides, on center and side bearings, by fatigued, cracked and broken spring planks, by abnormally early and severe fatigue in truck side frames and arch bars, by excessive hot-box trouble, excessive wear between journal-box and journal-bearing wedge, distortion of bearing surface of journal bearing, and by loosening of the lining from the brass shell.

Brake-beam safety hangers in the form of angles or bars, riveted or bolted to the spring plank, have not proved as effective in preventing loosened brake beams from dropping to the track as would be expected, chiefly due to rattle wear on the fastenings and subsequent loss of safety; it is an open question if the A. R. A. angle arrangement will fare much better.

How about truck springs? Has that problem been approached from the proper direction? Some of our cars have so much truck-spring capacity that when a car is empty or carrying a light load we do not get the proper cushioning effect, so that wheel shocks on the rail, not being properly cushioned, are much more severe than they should be, and for the same reason there is a repercussion of the shock on the supposedly sprung part of the car that is in a large measure transmitted back to the truck frame and its directly related parts and adjuncts. Truck-spring snubbers and other cushion devices and arrangements that provide ample protection with a minimum spring capacity are steps in the right direction.

Are there not other truck conditions of a more or less fundamental character in our present construction that may well be modified to provide a smoother running machine and thereby reduce or eliminate many of our troubles, including wear and tear on the parts of the foundation brake rigging?

PULLMAN VETERAN STILL CARRIES ON.—Like old soldiers, old railway coaches never seem to die; they merely fade away. At least, this is the thought expressed by the press department of the Canadian National in announcing the discovery that a 61-year-old Pullman sleeping car is now doing duty as a general storehouse on the western shore of Hudson Bay. The records show that this ancient Pullman was built in August, 1872, and was named the "Conway." It ran on the old Eastern Railroad of Massachusetts until 1880, when it was remodeled and given the new name of "Capitano." In its rehabilitated state, it boasted a barber shop and a bathroom. In 1904, "Capitano" was sold to some one who wanted a private car and at a later date it was again renamed, this time "Marlborough." From then on, it drifted from one place to another until it finally came into the hands of a railroad contractor and through him to the Canadian National, which transformed it into a business car for the chief engineer engaged in the construction of the Hudson Bay Railway. The car has now outlived its usefulness even for that purpose and, a mere shell of its former self, it serves as a storehouse on the railway at Canada's most northern port, Churchill.

Alec and Dave Fix a Brake Beam

By T. J. Lewis

LAST week was a bad week for Alec. He must have lost his rabbit foot or had a black cat cross his road. If it wasn't one trouble it was two. His work stayed "gummed up" all the week and even Dave got the better of him on every deal.

To begin with, he missed seeing a defect card on a car on which repairs had already been made. That, of course, was an awful crime, since it had been caught by an inspector up the road; but the blamed things are so unusual these days and, besides, they are often so inconveniently located, that there is little wonder that a fellow misses one occasionally. Then, a car on which he had cleaned, oiled and tested the air brakes had been pulled off the repair track, put in a "hurry up" train and left town without being stenciled, all while Alec was at lunch. Further, if a car inspector wants to get into real hot water, just let him have a hot box on a passenger train. Alec had two in one day. It just seemed that if a fellow was to get by at all he'd have to go with his fingers crossed all the time.

All these matters were dragging themselves slowly and sorely across Alec's mental vision the other morning as he finished his interchange work and started to the rip track. Just then Dave stepped out from behind a cut of cars on his own interchange and said "Hello, Alec."

Alec said, "Hello, yourself. How are you feeling, Dave?"

"All right, I reckon," said Dave. "Hadn't really felt of myself to find out."

Dave seemed to be in no particular hurry, so he went along with Alec until they came to Alec's rip track, then gave the cars in the shop the "once over" as they went. Soon they came to one of Dave's cars that had been shopped for a brake beam. The nut had lost off the brake beam truss rod and the beam had pulled some of the bow out of it which made the rod too short.

Alec said he didn't think he had a beam of that sort and was not sure yet how he would manage it.

That statement by Alec gave Dave a thought and he set in at once to see if he couldn't get around Alec to keep him from billing the car for a brake beam. So he became very mollifying and began to minimize the job of repairing the beam by saying "Why, Alec, I wouldn't think of going to the trouble of changing beams. I'd just put a nut on that truss rod, tighten it up good and let it go at that."

If Alec had not been feeling blue and all out of "sorts" he would not have considered Dave's proposal but, more or less thoughtlessly, he remarked: "I hardly think it's worth while, Dave. You see the end of the rod is back flush with the brake head now and I'd hardly be able to get a full nut on the rod."

Dave had noticed how indifferent Alec had seemed to be and took advantage of it to press his idea of saving his railroad a repair bill. So, taking care not to appear too keen, he set in to get around Alec in this way: "Just let off a few turns on the nut on the other end of that rod, Alec, and you can fix it right up. Then if you should need a little more 'set' in the beam, just slip a couple of running board saddles, or something like that, in between the back of the brake head and the spring plank and set a journal jack between that crosstie and the middle of the beam and you can jack all the 'hump' in that beam you want"; adding as an after-thought,—"chock the wheels, of course, to keep the car from rolling off the jack."

Alec was becoming a little irritated at Dave for his persistence, but took it for a natural feeling and found himself starting to follow Dave's suggestions.

"Entirely too much fiddle-faddle, Dave," Alec said, "I don't like the idea of so much banjo-work. I will let off on that other nut and if I can fix it that way, alright, if I can't, I'll change it and be through with it."

ALEC started one of his repair men to the tool house for a socket wrench and a nut, while he and the other man undertook to see what could be done about loosening the nut on the other end of the brake beam. When Dave saw them getting busy on the job he left, feeling a little mean about having persuaded Alec to undertake a job of that kind. Soon they had the wrench and nut and set to work and after the usual amount of pulling and tugging with just enough cussing to get by with that sort of a job, Alec found that he could not get a full nut on the truss rod. Then, as he was making a final effort, the wrench slipped and he barked three knuckles on the journal box. Then he threw down the wrench and proceeded to express his opinion of Dave for recommending such a job, of himself, or any other man for being bone-headed enough to undertake it.

But what would he do? He had no beam of that kind. As he threw the wrench down he realized that he would have to pick it up again. That did not dispose of the repair job on the car. It had to be man-handled and right away, too.

Going back to the car, he knelt down, leaned the wrench against the truck side and looked at the brake beam and just kept looking—looking for nothing in particular. Then the brake beam truss rod caught his eye. After staring at it a moment he shifted his glance quickly to the nut he had started on the end of it, took hold of the nut, then slipped his rule out and measured it. Yes, it was a 1⅛-in. nut alright, but that rod looked entirely too small. Reaching into his jumper pocket for his calipers, he calipered the rod and found it to be only one inch in diameter. That, of course, made it a No. 1 beam and so only scrap iron.

Calling to Jim, the car repairer, Alec said: "We'll have to rig up some sort of a brake beam for this job. This is an old No. 1 beam on here. It has a one-inch truss rod with the ends upset to make it big enough to thread an inch and an eighth."

Alec went over to the scrap bin and looked it over and called back to Jim, "Hey, Jim, here's an old scrap beam here with both heads worn out. We'll get it, and there's a couple of old second hand heads on the platform, get them, and we'll rig up something for it." Just then a freight extra came pulling in and, of course, Alec had to go to inspect it, so as he left he called over his shoulder, "You fellers go ahead, Jim, and fix it up the best you can, I gotta go now." They went ahead.

Dave happened to have it easy that day, very little work to do, so early in the afternoon he came "oozing" around to Alec's shack. Alec saw him coming and decided to "razz" him some and thus get an installment payment for those three skinned knuckles. Hunting out the billing repair card for the brake beam, he placed it on the top of the pile and laid the stack over on the end of his table-desk near where Dave always parked himself. True to form, Dave came "barging" in with a lusty "Hello, Alec," and plopped one long leg across the corner of Alec's table, crossed the other over it and asked, "How's business?"

"Alright, I guess, if anybody'd do it," Alec answered.

"Do what?" Dave asked, as his jaw dropped a little.

"Business, of course," Alec said, "what was you talking about?"

"Oh, Mr. Solomon, you been turning the emery wheel, or just the grind sto — Say! What the devil is this?" as his eye caught sight of the repair card.

"What does it look like?" Alec asked.

"Well," said Dave, "first rattle out o' the box, it looks like a helluva fudge to me."

"O yes, everything looks like fudge to you. I think you must have been brought up on it," Alec said.

Sure, Dave was not the man to be put off once he started to dig into a repair bill, so he continued:

"Really, Alec, you don't think you can charge for a brake beam just for the little work you did on that job, do you?"

"Well," Alec came back, "what do you expect me to do? All that work for nothing? Not on your life. And three barked knuckles to boot? Not me. I'm going to get paid for that job, whether you like it or not?"

"Nobody is going to object to you getting pay for what you do, Alec, but Rule 16 says 'Charges must be confined to actual work performed,' and all you did was to put a nut on that brake beam truss rod," Dave said, and continued, "I was there when you started the nut on."

"You was not there when that blamed wrench slipped and caused me to bark my knuckles on the journal box, was you?" Alec asked, the while gingerly petting said knuckles with his other hand.

"No," said Dave, "me being of a sort of religious turn, I'm glad I was not in hearing when that happened."

"'Sort' was well used there," said Alec, "but just how would you go about making a bill for that job?" he asked and went on "you know there is no provision in the rules for making a charge for repairing a brake beam on a car, nor is there any charge that can be made for just a one and one-eighth inch nut; so you think I should work on your blamed old car, put it in ship-shape and send it home to you free of charge, do you?"

"O, no," Dave answered, "there's no objection to you getting pay for what you do, but there is objection to you billing for what you don't do."

"Now see here," said Alec, "if I had taken that beam out and put another one in its place or if I had taken it out and put that nut on and put the same beam back, my charge of a second hand beam complete would have been correct, wouldn't it?"

"Sure it would," Dave replied.

"Well, what do you care whether I take the beam out to put the nut on or whether I put it on while the beam is still on the car?" Alec wanted to know.

"Don't make a bit of difference to me," Dave said, "it's my business to see, as far as I can, that when you bill our cars, you bill 'em according to the rules. Besides," he continued, "I didn't make the rules—I just try to work by 'em."

Alec saw that Dave was pretty well stirred up, so he decided to let up on him, so he said:

"Well, Dave, I was just trying you out on that rule, to see if you would be as contrary as usual, and I find that you will, so I'll tell you, I had to change that brake beam, because the defective one on the car was an old, out-of-date No. 1 beam and if I had changed it in kind, I would have got no pay for it and, not being overly fond of working and spending the company's good time for nothing, I just rebuilt a second-hand beam and put it on and made my bill accordingly, so you see the account is square after all.

Dave snorted, "Smart-Alec, huh? Well, since you've been so nice as to tell me all about it, let's just go out there and take a look at the whole job."

AS they passed the scrap bin, Dave had to stop and caliper the truss rod of the old beam to see for himself if Alec was right. That done he sauntered on over to the car and gave it the "once over," then came to the brake beam, stopped, looked at it, then went around on the other side of the car and looked again. Then he exploded:

"What the hell do you mean, Alec, by turning one of them brake heads bottom upwards? If you was going to do the job, why didn't you do it right?"

Alec, looking himself, saw what Jim had done, then he said:

"Well, I'll be damned!" But after a little consideration he said, "Why, Dave, here's what happened."

"Jim found that both of those old brake heads were right hand heads, so all he could do was to turn one of them bottom up'ards. Course it don't make any difference, it's a center-hung head anyway."

"Difference, hell!" Dave snorted, "all you think about is your damned repair bill. Second paragraph of Rule 16 says, 'Repairs to foreign cars must conform, in detail, to original construction,' with certain exceptions and that is not one of the exceptions. That brake head is bottom up'ards, Alec, it's just bottom up'ards, that's all. I'm going to contest your bill unless you correct that repair job."

Then Alec's dome cap went off.

"Bottom up'ards is it? Bottom up'ards! Well, what if it is? I reckon when you put in a pair of wheels you look to see if they're bottom up'ards don'tcha? Why, this old trap's 21 years old, stenciled here on the side, 'Built 1912.' It's been patched in every State in the Union and Canada to boot. Now you want to talk about 'original construction,' why the man that made it couldn't tell what the original construction was. Just take a look at the other end there, there's a whole brake beam some one has put on bottom up'ards. We just got it from you less than a week ago. It's only been up to Mallory with a load of lumber. We'er all lucky it made the trip." Alec's breath being exhausted, he stopped and looked at Dave.

Dave was stamping around the other end of the car with his hands rammed deep in his overall pockets and when Alec finished his "say" Dave was quiet and thoughtful for a moment, then raising his head, looked straight at Alec and said, "I'll tell you what Alec, let's go to the show tonight. There's a good one on at the Bijou."

After a moment's hesitation, Alec said, "Might as well, I reckon."

"Alright," said Dave, "I'll meetcha at the drug store 'bout 7:30." So saying, he turned and "ambled" off toward his own shack, softly whistling, "Meet me in St. Louis."

A New System of Cleaning Tank Cars

AN automatic, mechanical, tank-car washing machine, designed and built by the Pyrate Corporation, Portland, Ore., has been thoroughly tested during the past 12 months by the Union Pacific at Los Angeles, Cal., and the General American Tank Car Corporation at Chicago. The machine is used to apply chemicals to tank-car interiors automatically and mechan-

ically, providing cleaner cars at substantially less cost than by present hand-cleaning methods. It is estimated that the Pyrate system saves approximately 50 per cent in labor and material costs, also reducing by a similar amount the time which cars must be held out of service for the cleaning operation.

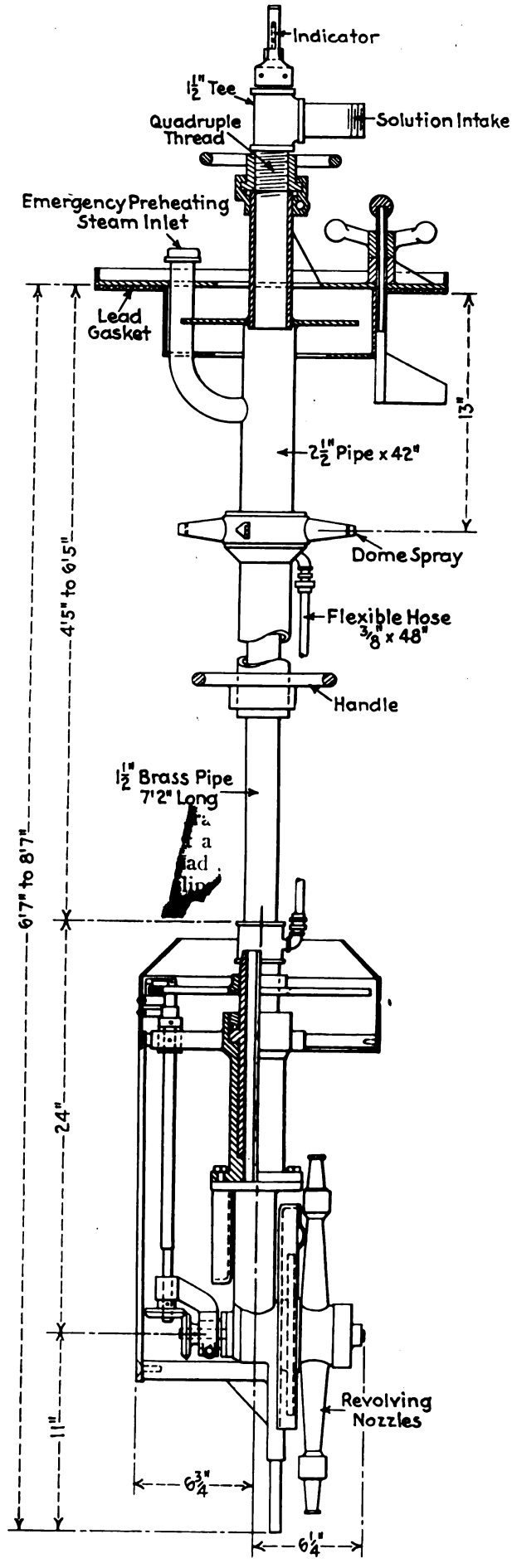
The Pyrate process involves the cleaning of all kinds of tank-car loadings in the edible and inedible oil and grease class, fuel and lubricating oils in the petroleum class; also various kinds of chemical loadings. The mechanical cleaning machine is said to do unusually effective work, enabling changes in car service to be made from one commodity to another without contamination of the lading. Another important advantage is the elimination, in most instances, of the necessity of steaming the cars before cleaning. Labor conditions in the repair yards and cleaning tracks also are improved, since it is easier to clean tank cars, and, owing to the more thorough cleaning of the cars, men using cutting or welding torches on repair work can operate with less discomfort and danger from smoke and gases.

The illustrations show Pyrate tank-car cleaning machines installed on a double-track rack at the East Chicago plant of the General American Tank Car Corporation. While two machines are included in this set-up, it is anticipated that more will be installed at such a time as production demands warrant. These machines are leased by the Pyrate Corporation, which, in turn, supplies the chemicals required in the cleaning operation.

The Pyrate machine is made almost entirely of bronze and brass to eliminate the possibility of ignition by sparking, should the machine accidentally bump against the inside of a car containing inflammable gases. Special attention has been given to wearing parts, stainless steel being used wherever possible. As may be seen from the illustrations, the machine comprises essentially a pipe assembly extending through a false dome cover and provided with a three-inch flexible wire wound hose connection at the top to supply the cleaning chemical under pressure; a standard steam hose connection at the dome cover for use when it is necessary to steam the cars; a series of four stationary nozzles just below the false cover and used in cleaning the dome; and a pair of rotating nozzles at the lower end of the pipe for cleaning the interior of the main tank. These lower nozzles revolve slowly in a vertical plane and also in a horizontal plane under gear drive from a small turbine, thus cleaning effectively all interior parts of the tank.

The machine is supported by a counterweight from a swing crane over the cars, thus permitting its ready application to, or removal from, the tank-car dome. The dome cover is clamped in place by means of wing nuts and adjustable clamps. An adjustment feature permits lowering the revolving nozzles to the proper position near the center line of the tank, regardless of the tank's size. The dome cover also is designed to fit all standard sizes of dome openings. All projecting parts of the machine are well guarded against any damage which might occur in handling.

During the actual cleaning operation, the prepared chemical solution, contained in tanks below the ground, is forced, by means of a steam pump, through pipes into the machine and out of the rotating nozzles in two concentrated streams under 150-lb. pressure. At this pressure and with the nozzle size and design provided, the two streams of a chemical solution can be thrown, in practically a straight line, a distance of over 60 ft. The nozzles revolve in a vertical plane step by step, a degree at a time, and the entire nozzle support and gear drive assembly revolves about a vertical axis at a speed which is automatically varied so that twice as much time is al-



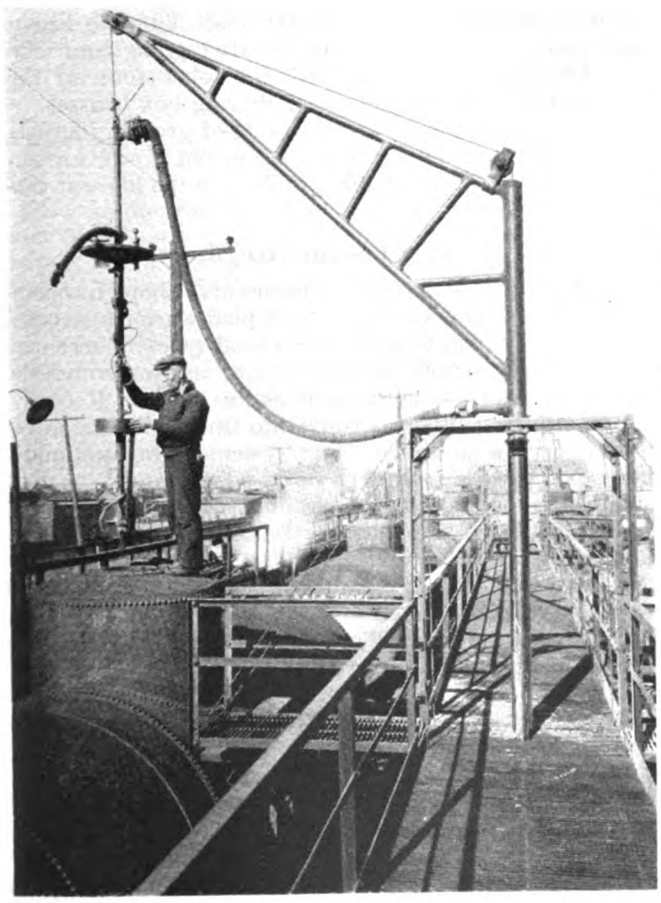
Assembly drawing of the Pyrate tank-car washing machine

lowed for cleaning the ends of the car as is used in cleaning the sides. Two underground storage tanks of 1,000-gal. capacity each are used for the chemicals, one for the cleaning of petroleum service cars and the other for edible and inedible commodity cars.

In practically all 10,000- and 12,000-gal. tank cars, no vertical adjustment of the machine is necessary in the cleaning operation, as the nozzles work at any point desirable between the top and bottom sheets. However, in some 6,000- and 8,000-gal. tanks, which are lower and longer, the angle at which the stream strikes some of the sheets in the car is quite small. To increase this angle of action to a sharper or more direct hit, the machine, while working, is raised and lowered by turning a wheel which revolves on a quadruple thread. Half the cleaning operation can then be performed with the machine near the top of the car and the remaining half with it located near the bottom. This enables the two streams of cleaning solution to strike the tank sheets more directly and effectively.

The machine is said to perform the following duties: Apply heat at a constant temperature; apply a scrubbing force for cleaning with a chemical especially prepared to attack the substance to be cleaned and still allow it to be rinsed free. After the mechanical cleaning operation is completed, the car is cooled by the machine in about 15 min. so that a man can enter the dome to brush out any remaining sludge and water which does not drain out.

The alkaline chemicals furnished by the Pyrate Products Corporation and used in the cleaning operations are the result of several years' experiment with all types of car cleaning. For deodorizing tank cars previously loaded with such products as petroleum, fish oil, etc., this company has developed a new product known as Pyrasol, a stable form of chlorine, which performs the double function of cleaning and deodorizing. Pyrasol, which comes in crystalline form, previous to solution, has also been used for cleaning and deodorizing refrigerator cars.



View of the Pyrate automatic, mechanical, tank-car washing machine as installed at the double-track cleaning rack of the General American Tank Car Corporation at East Chicago

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Joint Evidence for Improper Work

The Union Pacific executed joint evidence cards for alleged improper work and work claimed not performed on a number of Union Pacific cars returned by the Missouri Pacific at Kansas City for items such as coupler yoke rivets improperly applied; defective air brakes; air brake retainer valves not cleaned and improper second-hand brake beams applied, and presented these cards to the Missouri Pacific along with billing repair cars. The joint evidence cards were rejected by the Mo. P. on the grounds that Rules 12 and 13 do not authorize the use of joint evidence to establish liability on the part of the repairing line in the cases in question. The Union Pacific contended that joint evidence was final and that the Mo. P. should furnish defect cards to cover. In the case of the cars involving loose coupler-yoke rivets the Mo. P. stated that the cars left its repair tracks with rivets tight and in first-class condition and contended that it was entirely possible that the rivets might become loose or broken in subsequent yard or road movements. The Mo. P. contended that the air brakes on the cars in question were properly cleaned under the provisions of Rule 60 and, in the case of the retainer valves, it was claimed that it is impossible for anyone to state positively whether or not such valves have been cleaned two or more days after the work has been done, particularly in damp, rainy weather. The Mo. P. refused to recognize the use of joint evidence in all of the cases where it was shown that "brakes would not set in position No. 2 or release in position No. 4," claiming that the brakes on the cars involved were cleaned in accordance with Rule 60.

In a decision, rendered November 4, 1932, the Arbitration Committee said that "Rule 12 does not authorize the use of the joint evidence card for the purpose of determining whether or not work was actually performed or whether serviceable second-hand material was used. A definite statement has been made by the repairing road that the cleaning reported was actually done and that brake beams were not defective at the time of application. Therefore, the contention of the Union Pacific is sustained in only where joint evidence shows that air brakes failed to pass the required tests by the single-car testing device, and were subsequently cleaned within 60 days in accordance with the provisions of Rule 60, Section (i), Paragraph (4) "—*Case No. 1721, Union Pacific vs. Missouri Pacific.*

In the Back Shop and Enginehouse

Locomotive Repair Shops And Modern Locomotives*

By John Roberts†

I feel sure that all mechanical officers will agree that, generally speaking, our present locomotive repair shops are not at all adequate to meet the needs of the power of today. The relation of the locomotive shops to the locomotive itself is too closely allied to be ignored any longer, if the railroad companies are to avail themselves of its maximum efficiency.

When we look around our many shops, one has to admit that the locomotive shop and shop practice have not kept pace with recent locomotive developments. Of course, there are various reasons for this condition—principally, I think most locomotive repair plants were built before the present-day power was developed—consequently, the larger locomotive finds itself in a place altogether too small and not adapted to its needs. Unfortunately, the mechanical department has too often been looked upon as a "spending department," and the mechanical officers find it difficult sometimes to get the necessary capital to keep their equipment up-to-date, with the result that a great many obsolete machine tools are still in operation at a loss to the company.

If we contrast this condition with the automobile industry, what do we find? No sooner does a machine or tool become obsolete than it is replaced with the most efficient tool on the market—a new engine is developed, immediately the entire plant is re-organized.

The railway mechanical officer has himself partly to blame for what is sometimes referred to as inefficiency—he has been too prone to say (perhaps under pressure) "Yes, we can get along for another year!"

I also want to say, even in the face of all we read in our trade journals and railway periodicals, that the machine tool builder is also partly to blame. They have not in the past kept pace with the requirements of the locomotive shops—perhaps because of the limited market for their product. I do not mean this to cover standard tools, such as lathes, milling machines; shapers, etc.—what I have in mind is special requirements to give better production, reduce cost and increase efficiency. For instance, where would you find a high class piece of machinery today with the journal bearings turned and rolled, and yet this is what most locomotive shopmen are doing with the result that the very foundation of the locomotive is inefficiently machined at the start. I know it is an easy matter to grind the journals on the main driving axles before the wheels are applied—this can be done on any good piston rod grinder and is a practice which should be standard—but it is another matter to grind the journals after the wheels have been applied. Some few years ago we made a very careful study of this subject and found it would be a good practice to grind all journals on locomotive driving wheels, as we believed that apart from getting a more highly efficient job, considerable economy was to be effected. Unfortunately, however, there was no machine on the market in the United States or Canada, capable of doing this work. We then got one of our machine tool builders to look into the subject, with the result that a journal truing and grinding machine was developed—the first of which was installed in the new Canadian National shops at Montreal. Perhaps it would be interesting to give you a few figures taken at random as to the mileage made by ground journals and journal brasses.

Recently, we shopped one of our 5700 class Hudson type locomotives, which had made 247,101 miles, and the maximum amount of wear found on any driving journal was .025-in. and the maximum amount out of round was .012-in. These axles were calipered at the hub end, center and inside of the journal. The driving box brasses had lasted the full mileage of 247,101 miles. You will understand, of course, that these were floating bushing type driving boxes. An examination of our records show that from the five locomotives of this type operating on our road in fast passenger schedule between Montreal and Toronto, the average life of the driving box brasses was 177,109 miles, but one had to have two brasses renewed shortly after going into service. Omitting this one record, the other four of this type averaged 216,191 miles for driving box brasses.

Personally, I am a strong advocate of ground journals, and if you are thinking about it, do not go in for any makeshift job with portable grinders or the like—it cannot be done.

Type of Locomotive Shops

There are various types of locomotive shops in operation, but generally speaking, most plants are constructed either longitudinal type or transversal type. There may be advantages to both styles of shops, and sometimes the ground space available determines the layout. Recently, the longitudinal shop has come into favor with the introduction of the so-called "spot system." In our study, however, we decided to go to the transversal type of shop—first because of the ground space available, and secondly because we thought we could develop a shop having the entire equipment under one roof, which has great advantages in a country where we get very cold weather during winter months. We also had in mind laying out a shop which would enable us to route materials from one department into another with the least possible travel.

I would like to tell you an interesting experience which was forced upon us when the railways now constituting the Canadian National were consolidated—and you may find this an interesting study if you go in for it. In this consolidation, we had practically five separate railroads—all furnished with their own rolling stock, their own shops in their respective territories, their own shop equipment and practices in operation. It certainly was a study. However, we decided to develop a set of standard maintenance regulations for the purpose of standardizing shop practices and also locomotives, and

*Abstract of a paper presented before the New England Railroad Club at a meeting held January 9, 1934.

† Chief of motive power and car equipment, Canadian National.

in doing so, we found that the shop methods of all our shops could be greatly improved—and do not forget that this consolidated railroad reaches from the Atlantic to the Pacific ocean, having a total mileage of 24,000 miles of railway, with a diversity of geographical and climatic conditions. However, the maintenance regulations were prepared and from this study, the new Point St. Charles shops[1] were built to embrace the standards which had been adopted.

Unit Measurement System

It was also felt that some standard measuring stick should be adopted for measuring shop production, particularly as some of our plants were working on a straight time basis, others were operating on a bonus system. To eliminate the bonus system was to remove the measuring stick in those shops. To introduce the bonus system in the other shops at that time was not desirable. It was then decided to develop some system which would enable the shop management to know what progress was being made. This was not an easy task. First, we tried to develop a measuring stick based on tractive effort, then on haulage capacity, and also on the potential horsepower basis, but none of these were practicable or sufficiently accurate to be of any value. It is also a well-known fact that the A. R. A. classification of repairs is of no value, because of the varied cost of reconditioning locomotives. Latterly, we adopted a unit measurement system based on the "man-hour"—this system has worked out very well and is sufficiently accurate to give us a close shop efficiency figure month by month for each locomotive and car repair shop.

Considering the large amount of money spent in labor and material per month in a large locomotive shop, it is not fair to the shop superintendent, unless you can give him some measuring stick by which he can tell what progress he is making.

Shop Methods

Let me here again refer to the subject of shop practices. I might say that on our railroad, on account of the size of the railway, which necessarily employ a large number of men in the mechanical department—having quite a number of shops scattered from the Atlantic to the Pacific—we have found it necessary to establish a shop methods department which comes under the jurisdiction of the mechanical department. This department has been a valuable asset, particularly as the men employed in it are trained mechanics who are used for inspection purposes, conversant in the operation of the unit measurement system and also developing shop practices and methods, etc. It would be interesting perhaps to mention that when our maintenance regulations were first developed, a limit of wear was established for the various moving parts, also tolerances of fits covering the locomotive machinery, etc.

Ground Journals—We have found that, as previously stated, the ground journal on the axle was a step in advance of any previous practice, also that a closer and better fit of the axle box, brasses, should be accomplished. We have adopted steel liners on our driving wheels and have found that the best material for this purpose is standard boiler plate. When these liners are applied by the welding process, they practically last the life of the wheel. We then found that to make a good application of brass liners to boxes, it was advisable to use the electric welding process for fastening the brass liners to the boxes. This particularly applies to a floating bush type. This can best be done by changing the polarity of the electric welding generator and using a special electrode for the purpose.

Piston rod work—Another practice which I think would be of interest is the machining and fitting of piston rods to crossheads. We grind all piston rods within .002-in. tolerance, being very careful to see that all radii are properly rounded out without tool marks, and the piston rod is then fitted to the crosshead. Gages and reamers are used for maching the crosshead to a standard taper and fit, making sure that the fit is properly smoothed out without tool marks. The end of the piston rod is also machined to a gage and carefully fitted to the piston and pressed into position. We do not approve of the common practice of drawing the piston rod up with a temporary key, as from our experience, we have found more fractures starting at the piston rod keyway through the use of the temporary key than otherwise. The enginehouses were also notified to eliminate breaking the crosshead fit as much as possible.

Grinding of Motion Links, Blocks, Etc.—I might also mention that an interesting development has been made in the motion gang, where we adopted a link grinder and an internal grinder combined, thus enabling one machine to take care of all the grinding work necessary in the motion gang. This means that we can grind our motion links and link blocks, and swinging the pendulum out when not in use, the grinding head (being a No. 2 internal grinder) takes care of grinding the motion bushes.

Nickel cast iron cylinders—A few years ago, we were almost at the point of going to a cast-steel cylinder, but in recent years, we have developed a locomotive cylinder manufactured from nickel iron (60 per cent steel and 1 per cent nickel) having a tensile strength of 35,000—40,000 lb. per sq. in. This metal has a Brinnell hardness of from 207 to 230, which is easily machined, giving a good smooth finish and a good grain structure in heavy sections.

Electric flue welding—The adoption of electric flue welding has also greatly assisted in getting longer tube mileage. Our practice is to lightly bead the flues at the back end and then electric weld them to the tube sheet—the flue being prossered on the water side of the back tube sheet before the bead is formed. Instructions are also issued that at each washout period, the flues are given a light prossering, which means that they are constantly kept up against the back of the tube sheet, and that by the prossering process the scale is removed from the flue on the inside of the tube sheet.

Firebox application—I feel sure that you will all agree that the welding process has also changed the method of locomotive repairs, particularly the application of new fireboxes, one-half side and three-quarter side sheets. At one time it was necessary to take the boiler out of the frames and send it to the boiler shop for firebox renewal. Now, with the present practice, new fireboxes can be applied in the erecting shop in four or five pieces.

Double-gunning of staybolts—A very interesting development which has greatly reduced the possibility of staybolt leakage is that of double-gunning staybolts. This is a process in which we use Chicago Pneumatic No. 11 pneumatic hammers supported by a pneumatic "holder-on"—both guns working on the inside and outside of the staybolts at the same time with an especially developed tool manufactured to expand the staybolt from the inside, thus tightening up on the thread on the firebox sheet. Of course, it must be understood that we are using exclusively hollow staybolt steel for this purpose. A leaky staybolt on our railroad is a thing of the past. We find that by the double-gunning process, we save on an average about 25 per cent over the old method of

[1](These shops were described in detail in the March, 1930 issue of the *Railway Mechanical Engineer*—EDITOR.)

staybolt application. A fair average performance on a straight away job on a side sheet is 50 to 55 staybolts per hour. At the same time this process removes the fatigue of the boilermaker, which makes it a preferable job from his point of view.

Heat treated tires—We are using heat treated tires. This necessarily caused us to develop a furnace with temperature control. Our Maintenance Regulations call for a maximum of 600 deg. F. for the application of tires, and prohibits any part of the tire being heated beyond 800 deg. F. It is necessary that this regulation be rigidly enforced in order that the temper of the heat treated tires which we use shall not be destroyed in the process of application. The electric tire heating furnace has an automatic pyrometer control, the power cutting out at 700 deg. F. and cutting in again when the temperature of the furnace drops to 650 deg. F. The capacity of the furnace is four tires per charge, and the tires remain in the furnace for about 90 min. The power is on for only about one-half this period, however, as the control cuts in and out as the temperature of the furnace rises and falls to the high and low limits. The load is approximately 90 kw. and, figuring on 1 cent per kilowatthour for power, the cost of heating would be 17 cents per tire.

Quartering machine—We have a special quartering machine which was developed by one of the machine tool companies. The first machine built was installed at Point St. Charles shops, Montreal. With the introduction of this machine, we find that it is possible to quarter our crankpins accurately within .002-in. for a 14-in. throw and the alignment is perfect. Since the introduction of this machine, we find it preferable, particularly on large power, to rough machine the crankpins to within a reasonable limit and finish them in the quartering machine, which gives us much more accurate work than finishing the crankpins and pressing them into place.

Locomotive spring repairs—I would also like to make mention of the subject of spring repairs. For a great many years, the practice in our locomotive shops for repairing springs has been simply governed by the "rule of thumb method." I also intend to show you a picture of our latest spring plant. All springs from locomotives undergoing repairs are sent to the spring shop for examination. If springs have no visible defects, they are put in the testing machine, and, provided they assume the correct height under load, they are lubricated by being immersed in a bath of leaf spring lubricant which is maintained at a temperature of 180 deg. F. After being immersed for 45 minutes, they are drained and sent back to the erecting shop.

For springs requiring repairs or new springs being made, the process is as follows:—The leaves are heated to a temperature not exceeding the hardening temperature and formed on the forming machine. After forming, the leaves are re-heated in the furnace to the correct temperature for quenching, quenched and then transferred to the drawback furnace. Electric furnaces are used for the entire process, with automatic pyrometer control. The leaves are inserted on edge, a complete set at a time and are separated from each other while the heating is being done. The hardening temperature is 1550 deg. F. for Carbon or Nickel Molybdenum steel—and 1650 deg. F. for Silico-Manganese or Chrome-Vanadium steel. The drawback temperature is 725 deg. F. for Carbon steel—830 to 900 deg. F. for Silico-Manganese—800 deg. F. for Chrome-Vanadium, and 850 deg. F. for Nickel-Molybdenum steel.

A Brinnell test is made right in the spring shop on a specimen plate from every heat, as a final check on the tempering of each spring. This only takes a minute or so and results in a wonderful uniformity of product. The Brinnell hardness required for ordinary carbon spring steel is 388, for silico-manganese or chrome-vanadium 388 to 418, and for nickel-molybdenum 418 to 430.

The spring buckles are die-forged from bar stock, the bar being lapped at the bottom of the buckle and upset at welding heat in a four-inch forging machine. The cost of these buckles is only about one-third of manually forged buckles and they are by far the most satisfactory buckles we have ever used.

The springs are assembled and banded in a press in the regular way and the buckles stamped. The springs are then tested for load and working height, and, after being lubricated as mentioned before, they are ready for delivery. It should be noted that about 25 per cent of the springs coming into the shop do not require any repairs, and not more than one-third show any broken plates. It is important when new leaves are being cut from a bar to turn the bar over at each cut in order to get the ragged edge on top at each end of the leaf.

Shop facilities for auxiliary equipments—With the introduction of various auxiliary equipments to locomotives, such as boosters, feedwater heaters, superheaters, exhaust steam injectors, stokers, etc., it has become necessary that these equipments should be assigned to a definite department of the shop for reconditioning, just as we assign our air brake equipment.

To my mind, the railway locomotive shops have been subjected to a good deal of undue criticism. Personally, I have often marveled at the splendid performance made in most of our large shops, considering the great disadvantage under which they are called upon to operate. I believe it is much simpler to build up an efficient organization in a manufacturing plant than in a railroad repair shop, particularly when one considers the diversity of operations that are necessary in reconditioning a locomotive—the many problems which the shop forces are faced with, on account of the condition of the locomotives when they arrive at the shops for repairs, also the many complications that enter into the problems on account of the location or the condition under which the locomotives have been operating. Some locomotives come from a bad water district, and you would naturally expect more boiler work than on locomotives coming from a good water district—the curvatures of the railroad, grade conditions, and many other conditions that enter into the wear and tear of the machine confront the shop staff with problems which are not common to any other industry within my knowledge.

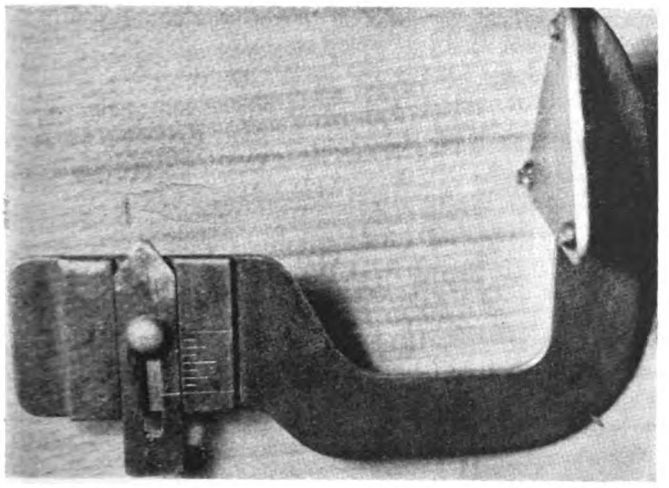
I believe that all railway mechanical officers should give most serious consideration to working to closer refinements in order to develop the best possible class of work known to us, so as to eliminate as much as possible unnecessary repairs at enginehouses.

Much can be done to improve the class of work which shops are called upon to perform. At the same time, let me say that we should also give serious consideration to the many rules and regulations under which we are compelled to operate. It seems to me that some of these rules and regulations which are enforced upon the railway companies were quite right and proper when they were developed, but are now obsolete. Take for instance the developments in locomotive boiler maintenance. The high grade of material used and the class of work performed by the railroads make it possible for us to get from 200,000 to 300,000 miles between retubing. Why locomotives should be taken out of service at the end of five years for external examination, when it is a known fact that the boilers are in good condition, is something that I cannot understand.

Tread Wear Gage For Locomotive Tires

THE tread-wear gage illustrated is for the purpose of quickly and accurately measuring the wear at the tread on locomotive tires and wrought-steel wheels.

The gage is made throughout of 1/8-in. sheet steel, cut and filed to shape. The triangular shaped piece was drilled for three 1/8-in. pins which were filed to 1/8 in. high, then the piece was welded to the body of the gage. The purpose of the three pins is to act as a three-point

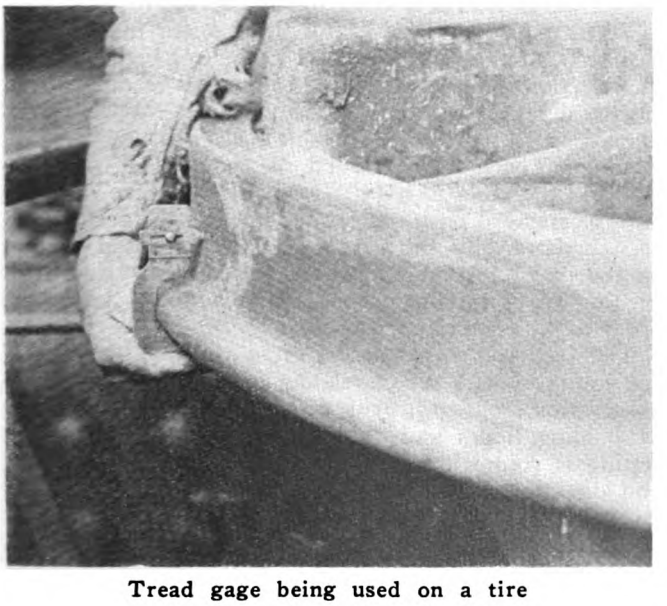


Close-up of the tread gage showing the construction

support for the gage on the inside face of the tire while measuring the height from the top of the flange to the tread.

The guides for the movable points were located to hold the pointer 2 7/8 in. from the back of the tire, which is the distance between the pointer and the three pins.

The pointer is slotted and held in position by a loose rivet with a light flat spring washer on the back of the gage. The graduations on the movable pointer are located by moving the pointer down 1 1/16 in. from the bot-



Tread gage being used on a tire

tom edge of the gage frame. This will be the first mark or zero which measures a tread of no wear or a flange of 1 1/8 in. standard height. The guide is then graduated in sixteenths to show a wear of 1 9/32 in. or more.

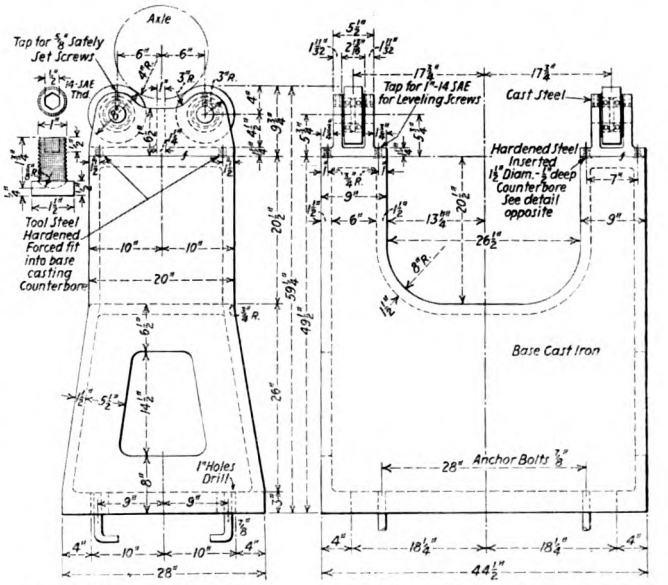
One of the photographs shows the finished gage with pointer set for no tread wear of a flange of 1 1/8 in. high. The other shows the gage in position on a tire for checking the tread wear. The wear should be checked at several different points on the same tire, usually the most wear is found at a point just in front or behind the crank pin and at each end of the counterbalance.

Driving-Wheel Counterbalancing

COUNTERBALANCING locomotive driving wheels without accurate and reliable devices for determining the figured weights are productive of doubtful and sometimes discouraging results.

At this time unusual interest is being displayed by members of the A. R. A. in both plain and cross-counterbalancing of locomotives for the elimination of axle and pin failures, together with the attendant effect on high-speed riding comfort, safety and speed.

The drawings shown here explain and describe a device for balancing driving wheels precisely and accur-



A rigid cast iron base anchored in concrete assures accurate balancing

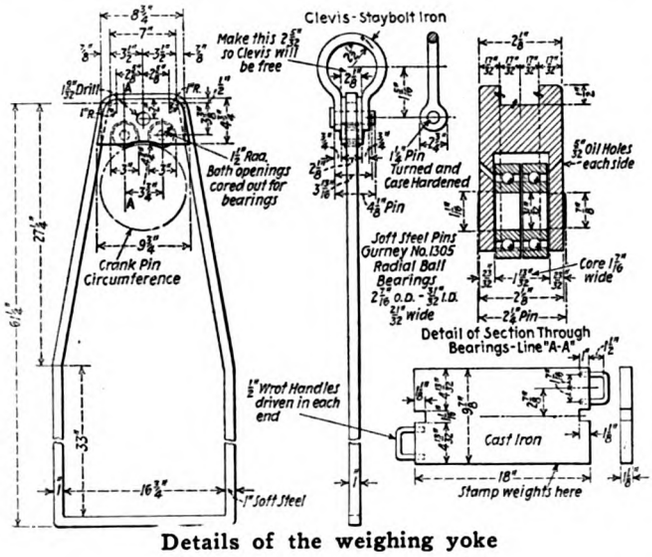
ately. The main portion consists of a cast-iron supporting base with a generous gap in the center to accommodate the center crank of a three-cylinder main wheel and axle assembly. The limits will fit axles ranging from 8 in. to 14 in. in diameter. The height is just enough to clear the yoke nicely from the floor when loaded for a heavy pair of main wheels. The base has a heavy section throughout and is not easily disturbed should the crane operator allow a pair of wheels to drop too hard. In addition, it is anchored to a suitable concrete foundation.

Cast-steel supports for the rollers are mounted on each end of the stand and each is provided with four S. A. E. adjusting screws which adjust against hardened-steel inserts in the top of the base, making alinement simple from the four corners and preventing the roller supports from shifting either way.

The rollers are made of plain carbon steel with case-hardened faces, which are polished to a glass-like finish. Each roller is supported by a 2 1/4-in. shaft and two annular ball bearings, also provided with retaining casing,

sealing them for the retention of oil and exclusion of foreign matter.

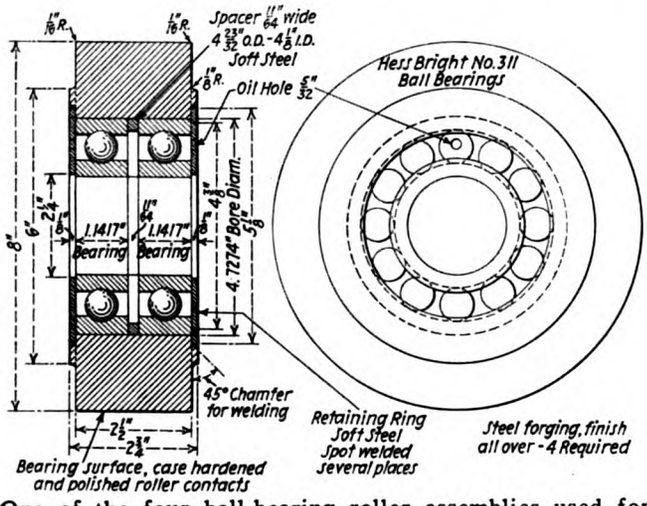
The weighing yoke is fitted with a ball-bearing housing for the pin bearings. This housing is of cast steel, cored out for the insertion of the quadruple, plain radial ball bearings. A wide bearing is desirable here on account of the step in pin diameters at the main for side and main-rod fits. The top portion of the bearing housing is grooved out to take the weighing yoke which is made in one piece. There is also centered here a



Details of the weighing yoke

large ringed clevice for a crane-hook connection to facilitate transferring the weights to opposite pins.

Cast-iron weights are made up in units of 50 lb. each. About 40 of these are provided, each stamped on the outside edge so the weight can be computed when they are piled up in the yoke. Smaller weights are also provided, several weighing 25, 10, 5 and 1 lb., the latter being made of sheet steel of varying thicknesses. Al-



One of the four ball-bearing roller assemblies used for supporting the driving axle

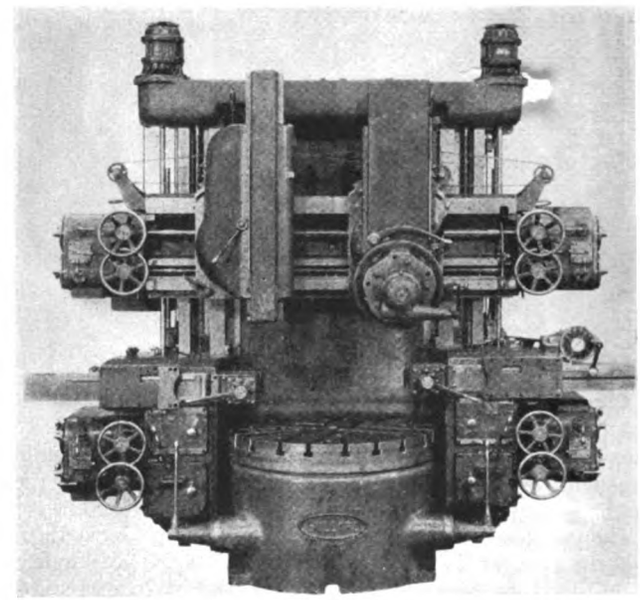
lowance in the total is also made for the total weight of the yoke assembly, which in this case is 283 lb.

The rollers are a decided advantage in design over the straight-edge ways in that the wheels stay in one place all the time. They will not injure the journals and they make the weighing more sensitive. The wheels when so mounted are very susceptible to small changes in weight and consequently better static balance is obtained.

Hydro-Shift Vertical Turret Lathe

THE development of the Hydro-Shift vertical turret lathe by the Bullard Company, Bridgeport, Conn., has made available a machine in which ease of control is combined with complete flexibility to make possible maximum output with the least effort on the part of the operator. This type of machine has been placed on the market in 56 in., 66 in., 76 in. and 86 in. sizes.

The controls are so arranged that the operator has full control of the machine from either side. Any one of sixteen speed changes may be selected by the movement of a crank lever which actuates a direct reading dial. The table speeds of the 56-in. machine, for ex-



The Bullard vertical turret lathe in which speed changes are made hydraulically

ample, vary, with a 900 r.p.m. motor, from 3.1 r.p.m. to 74.1 r.p.m. If the operator desires, for instance, to change from a table speed of 3.1 r.p.m. to a higher speed, the selection is made according to the dial reading without the necessity of stopping the machine. When ready to make the actual change of table speed after the desired reading has been set on the dial, the clutch lever is moved to bring the table to a full stop and then thrown back into the engaged position. In the interval the gears have been hydraulically shifted to the selected speed shown on the dial. It is not necessary under this system of shifting to figure the proper combination of levers in order to obtain the desired speed.

The feed controls, both on cross rail and side head, are equipped with direct reading micrometer dials with observation stops to provide a quick and accurate means of holding limits and duplicating sizes after the first setting is completed. Feed levers control the starting and direction of the feeds, while easily accessible trip levers on the front of the feed works provide a means of stopping instantly the feed of any desired head merely by the pressure of a finger. Power traverse handles are so designed as to spring into neutral immediately when the hand pressure is released, thereby avoiding the danger of being left in traverse and over-running the limit. A further safety device, known as an automatic overload kick-out, covers emergency cases of feed, preventing serious damage from jamming due to careless-

ness or overload. The feed works operate the power traverse at a rate of 13.75 ft. per min. Selector dials with knob controls located on the end of each feed works give a range of 16 feeds on all machines. Hammer hand wheels located on the front of the feed works and accessible from the working position enable the operator to move any of the heads or slides quickly over short distances. In addition this type of wheel permits accurate and fine feeding when starting or finishing cuts.

All of the heads of the Bullard Hydro-Shift are accurately counterbalanced through a system of steel cables and pulleys running on anti-friction bearings. By traveling the weights twice the distance of the sliding members it has been possible to reduce the weights to one half the amount usually required in counter-weighting systems. The counter-weights on this machine are so designed that very little manual effort on the part of the operator is required to move the heads. All of the counter-weights are covered or concealed within the machine, making not only for a neat appearance, but for safety as well.

The bed of the machine is formed by a heavily ribbed casting designed for extreme rigidity and to provide a firm support for the cross-rail, main head and side heads. The sliding members, such as the cross-rail, main head saddles, swivels and side heads, are single unit iron castings, proportionately heavy and properly ribbed to obtain maximum strength, long life with maintained accuracy and the elimination of weaving under heavy cutting. The cross-rail, which is provided with raising screws driven by an individual motor for raising and lowering, will accommodate two heads. The machine illustrated is a 56-in. size with left-hand ram type head for boring and right-hand turret type head. However, the machine may be optionally equipped with two ram type heads. The turret on the turret head is indexed by means of a crank handle driving through a worm gear, precluding the possibility of kick-back on the crank when heavy bars or tools for overbalance the tool weight at other stations of the turret while indexing. Each of the slides may be swiveled right or left at any angle up to 30 deg. Two main heads on the cross-rail are provided with feed works which permit rapid traverse, vertically or horizontally, each independently of the other.

Specifications of Hydro-Shift Vertical Turret Lathes

Capacity	56 in.	66 in.	76 in.	86 in.
Diameter	56 in.	66 in.	76 in.	88 in.
Under rail	47 in.	56¼ in.	62½ in.	68¼ in.
Under turret face	58¼ in.	67½ in.	73¾ in.	79½ in.
Table diameter	50 in.	61 in.	71 in.	83 in.
Turret rail head:				
Vertical movement	30 in.	30 in.	30 in.	30 in.
Will face	56 in.	66 in.	76 in.	88 in.
Left-hand ram head:				
Vertical movement	48 in.	48 in.	48 in.	48 in.
Will face	56 in.	66 in.	76 in.	88 in.
Feed changes:				
Number	16	16	16	16
Maximum	.500 in.	.500 in.	.500 in.	.500 in.
Minimum	.010 in.	.010 in.	.010 in.	.010 in.
Table speeds:				
Number	16	16	16	16
With 900 r.p.m motor:				
Minimum	3.1	2.6	2.2	1.9
Maximum	74.1	60.8	52.4	44.2
With 1,200 r.p.m. motor:				
Minimum	4.2	3.4	2.9	2.5
Maximum	99.5	80.7	69.5	58.8
With 1,200 r.p.m. motor and 17-tooth table pinion:				
Minimum	5.1	4.1	3.5	3.0
Maximum	120.0	98.0	85.0	71.5
Side heads:				
Vertical travel	35½ in.	44¾ in.	51 in.	56¾ in.
Horizontal travel	30⅜ in.	30⅜ in.	30⅜ in.	30⅜ in.
Max. diam. side head will turn	56 in.	66 in.	76 in.	88 in
Min. diam. side head will turn	0	5¾ in.	15¼ in.	29 in.
Floor space:				
Projected	170 in. by 180 in.	180 in. by 192 in.	190 in. by 208 in.	200 in. by 216 in.
Maximum height	173 in.	183 in.	189 in.	196 in.
Weight, two main heads and two side heads	52,000 lb.	61,000 lb.	68,000 lb.	77,000 lb.
Motors (same for all sizes):				
Main	40 hp., 900 r.p.m.			
Rail-raising motor	3 hp., 1,800 r.p.m.			
Power traverse motor	2 hp., 1,200 r.p.m.			

The lubrication system in the Hydro-Shift has been designed with a view to long machine life. The oil pump is located within the bed and connected directly to the head stock. It takes oil from the sump, passes it through the filter system and distributes it under pressure regulated to suit the various requirements. The ways of the rail, saddles and slides are thoroughly lubricated as are the feed screws, racks, pinnions and down feed rods. Forced lubrication is delivered to the spindle bearing and all other bearings, anti-friction or otherwise, throughout the head stock and side heads. The feed works contain their own reservoirs and are not connected to the main system. The filters in the lubrication system are so located near the bottom at the rear of the machine that it is not necessary to remove the rear machine cover in order to clean the filters. In the particular type of filter used it is only necessary to rotate the handle of the filters in order to clean the sludge from the filter and drop it into a sludge sump which is isolated from circulation. A pressure gage just above the speed control dial shows the oil pressure on the machine at all times and through this means indicates when it is desirable to clean the filters.

All of the functions of the main drive rapid traverse and rail raising are accomplished by means of push button control individual motors. Safety limit switches afford a means of protection to cross-rail alinement and mechanism. Both upward and downward movements of the cross-rail are protected by limit switches.

Where cutting-coolant systems are needed the 56-in. Hydro-Shift is provided with a separate water pan and pump, while for the larger sizes the pan is built into the concrete floor in order to give the most suitable foundation necessary for large machines and heavy cuts.

Stationary Cutting Machine

THE Linde Air Products Company, New York, has recently introduced a new stationary cutting machine known as the Pantosec, which is especially designed for cutting dies, cams and other parts that must be smoothly and accurately cut. This machine has a cutting range of 44 in. longitudinally, and 20 in. laterally, and it permits of straight-line cutting, angle cutting, beveling, circular cutting and intricate shape cutting. The floor space required by the machine is 72 in. by 83 in. The Pantosec may be operated from either the template end or the blowpipe end, as a hand-guided or machine-guided instrument. Angles may be cut without templates since the cutting head can be [illegible] locked for travel in either direction. Bevel cutting is simplified through the provision for adjusting the [illegible] machine to the work so as to make it possible to [illegible] line up the blowpipe without shifting the work, and the dividing head enables the operator to set stops on work that is to be cut in several directions.

An extension [illegible] so mounted as to be steady and secure makes it unnecessary for the operator to return to the back of the machine to start the profile cutting after the entry cut has been made.

The machine consists of a carriage mounted on three-point supports. The piping for the gases is all enclosed in the carriage and all drives are protected by dirt-proof casings. A motor for either 110- or 220-volt current may be specified. The wiring is concealed and switches and controls are labeled and easily accessible.

Among the Clubs and Associations

TORONTO RAILWAY CLUB.—Steel Processing was the subject discussed by F. A. Sherman, vice-president, Dominion Foundries & Steel, Ltd., before the meeting of the Toronto Railway Club on February 2.

NORTHWEST CAR MEN'S ASSOCIATION.—At the meeting of the Northwest Car Men's Association on February 5 proposed changes in the A. R. A. rules and the new loading rules were discussed.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—L. K. Sillcox, vice-president, New York Air Brake Company, presented a paper on the AB air brake at the February 5 meeting of the Indianapolis Car Inspection Association.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Changes in A. R. A. Loading Rules was the subject for discussion by C. J. Nelson, superintendent, the Chicago Car Interchange, before the meeting of the Car Foremen's Association of Chicago on February 12.

PURCHASES AND STORES DIVISION.—A contest for the best paper relating to railway purchasing and stores work has been announced by the Purchases and Stores Division, American Railway Association. As in contests held in previous years, all employees below the rank of assistant purchasing agent and assistant general storekeeper are eligible. ¶ Three members of the general committee of the division have been appointed to judge the papers, as follows: J. C. Kirk, assistant general storekeeper, Chicago, Rock Island & Pacific; G. H. Walder, purchasing agent, Chicago, Milwaukee, St. Paul & Pacific; and L. B. Wood, general storekeeper and assistant purchasing agent, Southern Pacific lines in Texas and Louisiana. Each paper must contain 1,000 to 3,000 words and must be submitted to W. J. Farrell, secretary, Division VI, Purchases and Stores Division, American Railway Association, 30 Vesey street, New York City, not later than April 1.

FOURTH INTERNATIONAL CONGRESS FOR APPLIED MECHANICS.—In accordance with the resolution adopted at Stockholm in 1930 the Fourth International Congress for Applied Mechanics will be held in Cambridge, England, July 3 to 9. An English organizing committee has been formed and the Applied Mechanics Division of the American Society of Mechanical Engineers is co-operating with the committee with the idea of co-ordinating the participation of other American groups in this congress. The subjects to be discussed will be grouped under four general headings: Rational Mechanics, including vibrations of structures and machines; Mechanics of Fluids, including turbulence, the boundary layer, heat transfer and compressible fluids; Materials, including elasticity, plasticity, fatigue and crystal structure, and Water Waves, including resistance and stability of ships and seaplanes. Inquiries regarding the Congress and promises of manuscripts should be addressed to the Applied Mechanics Division of the A. S. M. E., 29 West Thirty-Ninth street, New York. Summaries of about 300 words in length, written in English, German, French or Italian, will be required about April 1.

RAILWAY CLUB OF PITTSBURGH.—At a meeting of this club held at the Fort Pitt Hotel on January 25 John Dickson, engineer, Westinghouse Electric & Manufacturing Company presented a paper in which the possibilities of the Diesel engine in railroad service were discussed. Mr. Dickson told the story of the development of the Westinghouse Diesel engines which are now being built in several cylinder and horsepower combinations and described the design and construction of the engines. In concluding his paper the speaker emphasized the point that the advocates of Diesel engines for railroad service do not offer them as a facility for completely replacing steam locomotives but suggest the economic possibilities of this type for certain definite classes of service.

Directory

The following list gives names of Secretaries, dates of next regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 2205, 150 Broadway, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—Division V.—MECHANICAL.—V. R. Hawthorn, 59 East Van Buren street, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorn, Chicago.

DIVISION VI.—PURCHASE AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Columet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, Room 332, 30 Church street, New York.

MACHINE SHOP PRACTICE DIVISION.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—Edgar J. Kates, 1350 Broadway, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except June, July and August at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, La Salle Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth street, Council Bluffs, Iowa. Regular meetings, second Tuesday of each month at Council Bluffs.

CENTRAL RAILWAY CLUB OF BUFFALO.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month except June, July and August, at Hotel Statler, Buffalo.

CLEVELAND RAILWAY CLUB.—F. B. Frericks, 14416 Alder avenue, Cleveland, Ohio. Meeting second Monday each month, except June, July and August, at the Auditorium Hotel, East Sixth and St. Clair avenue, Cleveland.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon, 12:15 p. m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha street, Winona, Minn.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN.—C. L. Roberts, R. F. D. 5, Peoria, Ill.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md. Annual meeting October 17-18, Hotel Stevens, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver buiding, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

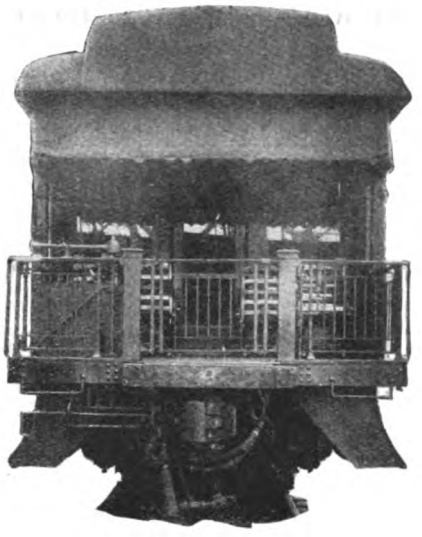
TORONTO RAILWAY CLUB.—N. A. Walford, district supervisor car service, Canadian National, Toronto, Ont. Meetings first Friday of each month except June, July and August.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—C. L. Emerson, 822 Straus Building, Chicago. Regular meetings third Monday in each month except June, July, August and September.



NEWS



THE LOUISVILLE & NASHVILLE, on January 16, recalled 800 men to work at its shops at Louisville, Ky.

THE CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC is inquiring for 25 baggage cars.

THE LOUISIANA & ARKANSAS is inquiring for three 2-8-2 type locomotives.

THE ALASKA RAILROAD is inquiring for 20 50-ton hopper-bottom coal cars.

THE DOW CHEMICAL COMPANY has ordered two aluminum tank cars of 8,000 gal. capacity from the General American Transportation Corporation.

THE CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC has awarded a contract to the Thorgersen & Ericksen Company, Chicago, for the construction of a blacksmith shop at Milwaukee, Wis., a portion of which was destroyed by fire on January 8. This is a one-story structure, 80 ft. by 416 ft., and is of concrete and steel construction. The reconstruction work will involve an expenditure of $46,000.

Progress on P.W.A. Loans

THE $3,300,000,000 fund appropriated for the P. W. A. has now been practically all allotted but more is expected at the hands of Congress and some considerable sums may yet be available from allotments which are not taken up. On January 25 it was announced that the first check had been mailed out by the Public Works Administration to the Pennsylvania for $6,990,000, as the first installment on the loan of $77,000,000 for electrification work and the acquisition of 7,000 freight cars and 101 electric locomotives. The money will be expended in the next 60 days. Many railroads that have been negotiating with the P. W. A. for loans have been delayed in the completion of their plans because of the difficulty in obtaining definite price quotation pending the adoption of the manufacturers' codes. However, it is expected that the codes for the locomotive and car manufacturers will be approved at an early date. The following allotments have been made in addition to those announced in the January issue:

Lehigh Valley.—The P. W. A. has allotted an additional $500,000 to this road for the purchase of five new locomotives.

Midland Continental.—This company has been allotted $40,000 by the P. W. A. for the purchase of one Diesel locomotive to cost approximately $52,000. The report of the Midland Continental to the commission states that the company operated such a locomotive experimentally for four months in 1932 and showed a saving of 0.66030552 mill a gross ton-mile as compared with the cost of operating a steam locomotive.

The New York, New Haven & Hartford has been allotted $2,000,000 additional by the P. W. A. for the purchase of 50 passenger cars. The company is now asking for bids for this equipment and for a streamlined train.

Further progress is noted in the preliminary inquiry sent out by the Central of Georgia and the orders of the Chesapeake & Ohio, the Erie and the New York, Chicago & St. Louis:

Freight cars	Passenger cars	Locomotives	Order placed with
	CENTRAL OF GEORGIA		
200 70-ton hoppers			
	CHESAPEAKE & OHIO*		
500 hoppers			Canton
850 hoppers			A. C. F.
1,000 gondolas			A. C. F.
50 automobile (with loading devices)			A. C. F.
1,150 hoppers			Standard Steel
650 steel box			P. C. & M.
750 hoppers			Ralston
100 furniture			Mt. Vernon
500 hoppers			Pressed Steel
2,250 hoppers			General American
	15 steel coaches		St. Louis Car
	11 steel mail and express		St. Louis Car
	ERIE		
500 50-ton automobile			A. C. F.
500 50-ton box†			A. C. F.
750 50-ton hoppers			Standard Steel
750 50-ton hoppers			Pressed Steel
750 50-ton hoppers			Greenville
250 70-ton hoppers			Ryan
125 70-ton flat			Ryan
100 40-ton furniture			Magor
	50 semi-suburban		A. C. F.
	50 suburban		P. C. & M.
	25 suburban		Pressed Steel
	NEW YORK, CHICAGO & ST. LOUIS*		
675 gondolas			Bethlehem
25 flat			Ryan
500 box			P. C. & M.
	5 coaches		P. C. & M.
	2 air-conditioned coaches		P. C. & M.
	1 steel mail and express		St. Louis Car
		15 2-8-4	American
		5 0-8-0	Lima
		20 tenders, 1,900 gal. cap.	Lima

* All of the freight cars for the C. & O. and N. Y. C. & St. L. are of 50 tons' capacity.
† 350 with loading devices.

The 500 freight cars to be purchased by the Lehigh & New England have been classified as follows: 250 steel box cars, 150 all-steel hopper cars, and 100 composite flat gondola sars.

The program of the Boston & Maine involves repairs to 25 locomotives, general repairs to 818 freight cars and 80 passenger cars, air-conditioning of 10 cars and new seats for 10 cars.

The 7,000 cars to be built by the Pennsylvania will consist of 500 steel box cars 40 ft. 6 in. long, 10 ft. high, and 9 ft. 2 in. wide, designed for carrying automobiles and equipped with mechanical loading devices enabling each car to haul four automobiles instead of two or three; 3,000 of this type of car without the automobile loader; 2,000 standard steel box cars and 1,500 flat cars 50 ft. long of 70 tons capacity.

Of the 7,000 cars, 166 box cars with loaders, 1,000 box cars without loaders, 668 standard steel box cars and 500 flat cars, a total of 2,334, will be built at the P. R. R. Altoona (Pa.), shops; 167 steel box cars with loaders, 1,000 box cars without loaders, 666 standard box cars and 500 flat cars, a total of 2,333 cars, will be built at its Enola shops, and the same number and types of cars will be built at its Pitcairn shops. This will provide a year's employment at Altoona for about 400 men, who will be required for work on the fabrication of material for all the cars and about 300 men who will be engaged in construction work. In addition 300 men employed on construction work will be given a year's employment at each of the other two shops.

Later in the year 101 electric locomotives—59 for freight service, 28 for passenger service and 14 switchers—will be acquired.

Splawn Appointment to I. C. C. Confirmed

THE PRESIDENT'S appointment of Dr. W. M. W. Splawn as a member of the Interstate Commerce Commission, succeeding Ezra Brainerd, Jr., was confirmed by the Senate on January 27, following a favorable report by the committee on interstate commerce on January 16 when opposition of the railroad labor organizations to the appointment of Dr. Splawn as a member of the Interstate Commerce Commission was withdrawn.

I. C. C. Inspectors Check Condition of Equipment

THE RESULTS of a detailed inspection of freight cars and locomotives, recently completed by the Bureau of Safety and Locomotive Inspection of the Interstate Commerce Commission, at the request of the Federal Co-ordinator of Transportation, were made public on January 4, as briefly reported in the January issue of the *Railway Mechanical Engineer*.

Late in the summer inquiries were directed to the Co-ordinator from various sources respecting the adequacy of freight equipment to protect possible increase in traffic during the fall months. It was generally recognized that considerable maintenance had been deferred and some doubt was expressed as to the ability of the railroads to meet the prospective demands. Freight car and locomotive statistics, maintained by the American Railway Association, and released currently through the Car Service Division, reflected an apparently satisfactory condition, but in view of the doubts expressed as to the entire accuracy of these reports, a special check was arranged for, Mr. Eastman explained.

The check covered a large portion of the cars reported as stored in serviceable condition, and most of the locomotives. It consisted of actual examination of the equipment by inspectors of the Interstate Commerce Commission.

"The facts developed by this examination lead to the conclusion that neither the fears of a freight-car shortage nor the optimism of those who relied upon railroad reports of surplus equipment were fully justified," according to Mr. Eastman's statement. "Had the anticipated increase in fall business been realized, it is probable that the supply of serviceable cars would have been fully absorbed, although the surplus was apparently sufficient, at least numerically, to have averted a serious shortage."

The railroads whose cars were examined reported as of October 1, 118,854 stored cars fit for the transportation of all commodities for which designed. The inspection developed that 55.5 per cent of these cars were fit for the service for which they were designed, and 4.4 per cent were found unfit for any service until given repairs estimated to cost $350 per car. The balance, comprising 40.1 per cent of the stored cars, were suitable for the transportation of certain commodities only. A further analysis of the reports shows that 56 per cent of the cars inspected were constructed prior to the year 1920. The cars covered by this survey did not include cars definitely classed as "Bad Order."

The check of locomotive condition was somewhat less assuring than that of freight cars. The railroads reported 5,549 locomotives stored in serviceable condition. Of these, 4,162 were inspected. Of those inspected, 3,275, or 78.7 per cent, were actually ready for service, while 887, or 21.3 per cent, were in need of repairs requiring three days or more time and the expenditure of $150 or more.

The locomotives were further classified as to type, age and tractive power. It was found that a substantial number of the stored locomotives were of types designed for switching and passenger service, and those whose wheel arrangement and tractive power would indicate their use for branch line and secondary service. Locomotives built prior to 1910 constitute 41.9 per cent of the stored power inspected, while an additional 39 per cent range from 13 to 23 years of age, leaving but 19.1 per cent less than 13 years old.

From the standpoint of tractive power, the adequacy of the locomotive reserve is still further out of proportion to the numerical ratio of stored locomotives to total owned. Of the units reported by the railroad as "stored serviceable," 41.5 per cent have tractive power less than 40,000 lb., while 62.5 per cent rate less than 50,000 lb. The locomotives under consideration do not include those definitely reported in Car Service Division bulletins as in "Bad Order" or awaiting shop for classified repairs.

Progress in Settling the Company Union Question

CO-ORDINATOR EASTMAN on January 22 addressed a communication to the three Regional Co-ordinating Committees on the "company union" question.

In a communication of December 7 he had offered seven definite suggestions, "to the end that railroad labor practices be brought into entire harmony with the law and that a permanent basis be laid for peaceful and co-operative relations." He also expressed the hope that the committees would assume the leadership necessary to accomplish the desired results.

Later, on January 4, he met with the three committees in joint conference and it was agreed that he should receive a further report in writing informing him of the action which the committees had taken or contemplated taking. He has since received such reports, as well as reports from various individual companies.

"It appears that the committees of both the eastern and the southern groups believe that they have no jurisdiction to take action in regard to this matter as committees under the Emergency Act, except so far as the labor practices in question may be found to constitute waste and preventable expense," Mr. Eastman says, "nevertheless, they have recommended to the railroads which they represent the posting of an appropriate notice to employees, as proposed in my communication of December 7.

"These proposed notices in some respects go beyond my suggestion, and call for some comment from me. . . ."

"It is true that neither the Emergency Act nor I have 'outlawed' so-called company unions. Such unions are not prohibited, if the employees wish organizations of this character. . . .

"The question is whether the company unions have been organized and selected to represent the employees 'without interference, influence, or coercion' on the part of the railroads. The information in my possession, derived largely from returns by the railroads to my questionnaire, indicates that many of them have not been so organized and selected. It is, of course, a question of fact in each case. . .

"The Western committee forwarded a copy of my communication of December 7 to each of the western railroads, requesting that it be advised whether or not the seven suggestions would be complied with. It appears that the railroads have followed the suggestions in one way or another quite generally.

"At the conference on January 4 it was also indicated that every effort would be made by the individual railroads to guard against the victimization by subordinate officials of employees who exercise their right to join the labor organization of their choice, and that any complaints with respect to such victimization which I receive would be handled promptly by each railroad president, if referred to him by me. This is being done."

Recent Air-Conditioning Orders

ORDERS PLACED for air-conditioning equipment to be installed in railroad-owned cars during the last few months have been more numerous than at any time heretofore. Orders placed by the railroads with the Pullman Car & Manufacturing Corporation recently are as follows:

Seaboard Air Line—15 cars, including 5 coaches, 5 coach-baggage cars, 3 coach-dining cars and 2 observation-dining cars.

New York Central—58 cars, including 36 dining cars and 22 coaches.

Great Northern—12 dining cars.

Northern Pacific—19 cars, including 9 dining cars and 10 observation cars.

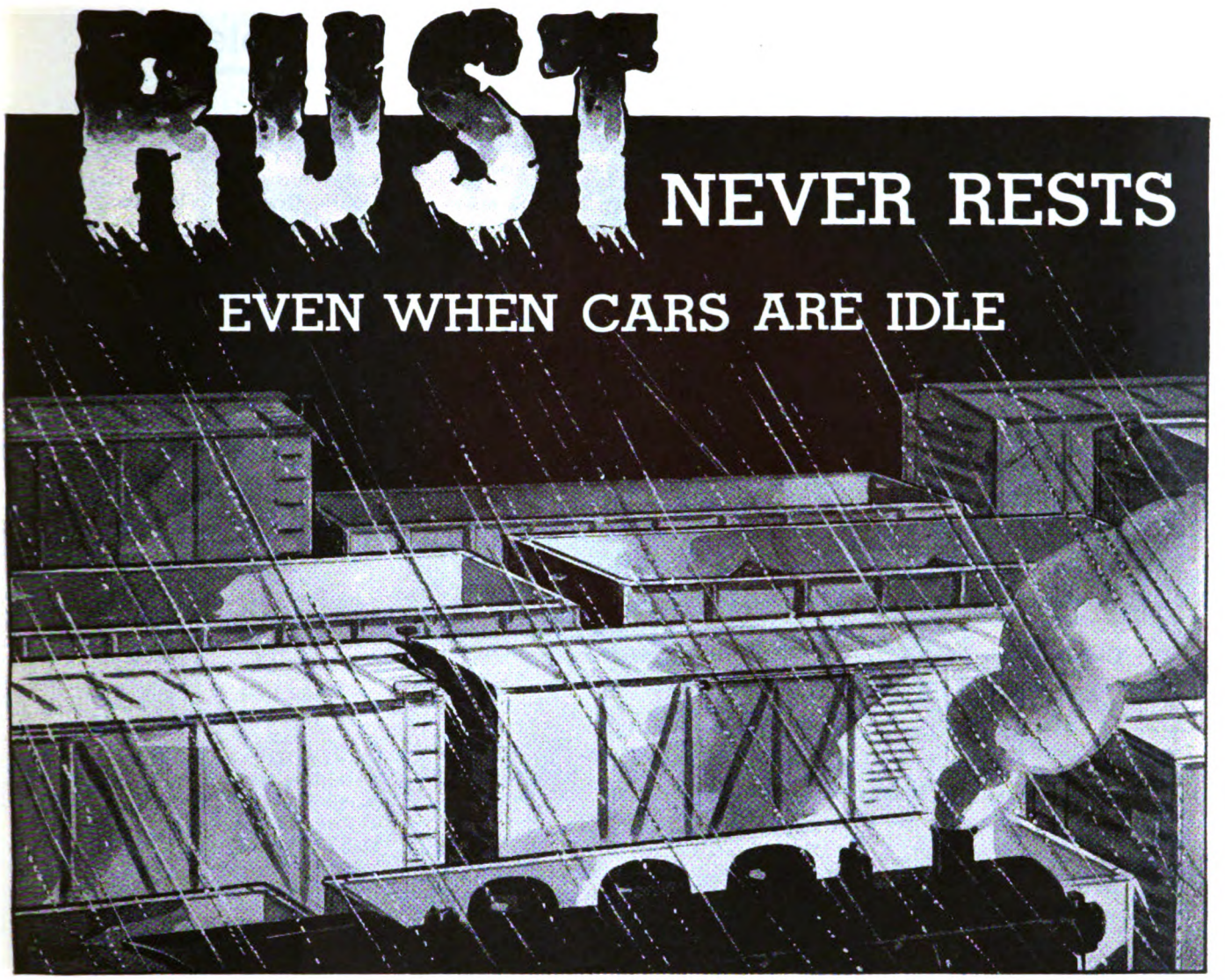
In addition to these, air-conditioning equipment is being installed in 480 sleeping cars for use on the Chicago, Rock Island & Pacific, the Seaboard Air Line, the Pennsylvania, the New York Central, the Chicago, Burlington & Quincy, the Great Northern and the Delaware, Lackawanna & Western.

The Atchison, Topeka & Santa Fe has ordered air-conditioning equipment for 26 passenger cars from the Safety Car Heating & Lighting Company. The cars involved include 14 dining cars, 10 lounge cars and 2 cafe cars, and the equipment will be installed in the company's shops at Topeka, Kan. This brings the total number of air-conditioned cars on the Santa Fe to 49.

Western Roads to Air-Condition 300 Cars

THE WESTERN RAILROADS have decided to air-condition the club, dining, lounge and observation cars in all of the principal through passenger trains operated in western territory prior to late spring, according to an announcement made by H. G. Taylor, chairman of the Western Association of Railway Executives. Final details of the plan have not yet been completed

(*Turn to next left-hand page*)



Long lines of idle cars stand exposed to the weather. First paint peels off and then rust and corrosion go to work on the metal itself. » » » Then the economy of providing protection to cars in the form of rust-resisting Toncan Iron becomes apparent. How soon those cars come in for repairs is dependent upon the ability of the car sheets to resist the attacks of rust and corrosion. » » » To get full value out of the dollar you spend for car repairs use materials that give maximum life. » » » Such a material is Toncan Iron. This alloy of refined iron, copper and molybdenum ranks first among the ferrous metals after expensive stainless irons and steels in its resistance to rust and corrosion. » » » Every car re-roofing job; every replacement of rusted plates is proof of the need for more resistant car materials. » » » Toncan Iron, by increasing service life where corrosion conditions are severe, gives assurance of longer life wherever rust—the destroyer—is at work. » » » Considered on a cost-per-year basis, Toncan Iron is the most economical car repair material. » » » In these days of waste elimination, Toncan Iron deserves full consideration in your effort to reduce costs.

Toncan Iron Boiler Tubes, Pipe, Plates, Culverts, Rivets, Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel.

The Birdsboro Steel Foundry & Machine Company of Birdsboro, Pa. has manufactured and is prepared to supply, under license, Toncan Copper Molybdenum Iron castings for locomotives.

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but it is estimated that it will include the installation of air-conditioning equipment in at least 300 cars additional to cars now so equipped.

The Standard 50-Ton Box Car

THE REGIONAL CO-ORDINATING Committees, representing the railways, have received communications from Co-ordinator Eastman, referring to the prospects for a considerable amount of car buying in the near future, as a result of the offer of the Public Works Administration to make loans to the railroads for that purpose. Five sample cars to the A. R. A. standard 50-ton, steel-sheathed, wood-lined box car designs have been built under the direction of the Car Construction Committee, Mechanical Division, American Railway Association, and have been tested at the plant of the Pullman Company. It is expected that a report of these tests, as well as observations and tests made by some of the railroads, will be submitted shortly to the Car Construction Committee and the General Committee of the Mechanical Division, to determine whether any changes or modifications are necessary in any of the sample cars.

Cleaning Air Brakes

THE SUBJECT of cleaning, oiling, testing and stenciling K-1 and K-2 air brakes is covered in a letter to members of the American Railway Association, Mechanical Division, issued under date of January 11 and signed by Secretary V. R. Hawthorne. The letter is as follows:

Rule 144 of the Rules Governing the Maintenance of Brake and Train Air Signals Equipment as revised effective August 1, 1933, and contained in Supplement No. 1 to these rules, provides that:

"At points where repairs to triple valves are made, involving main piston bushing, main piston, graduating valve, emergency piston, main piston ring, slide valve, emergency piston bushing or emergency valve brass seat, inclusive, such triple valves must be dismantled and *all parts for which A. R. A. gages are provided must be checked for wear, with gages specified.* Parts which do not conform to specified dimensions of these gages must be replaced with parts known to be within said gage limits."

Air Brake Rule 143, as revised effective August 1, 1933, further provides that "all triple valves after being cleaned or repaired must be tested on an A. R. A. standard test rack and pass the prescribed test before being placed in service. *'K' triple valves must also be tested for feed groove location.*" Letter ballot of 1933 included the adoption, as standard, of the following requirement: "A. R. A. standard triple valve test racks must be equipped with a device for locating the position of the feed groove. The device shown in Figure 1 (Circular DV-807, page 8), as furnished by the air brake manufacturers, or its equivalent, will meet the above requirements."

Interchange Rule 60, Section (g), provides that: "The cleaning marks must not be changed, or charges made for periodical cleaning of air brakes as per item 13 of Rule 111, unless all work is properly performed as required by the Standard Instructions for Periodical Repairs to Air Brakes on Freight Cars, *including the use of all A. R. A. standard triple valve wear limit gages, or approved equivalent, for checking wear, when any of the listed internal triple valve parts require repairs or renewal as prescribed therein.*"

It has been ruled that sufficient time has now elapsed to enable all railroads and car owners to provide proper gages for checking wear of triple valve parts and devices for locating the position of the feed groove, and issuing proper instructions for their use. Therefore, where these gages or devices are not being used as required by air brake Rules 143 and 144, charge for cleaning, oiling and repairing of "K" brake equipment as per item 13 of Rule 111 is not permitted, nor may the air brake cleaning marks on car be changed.

Where violation of Rules 143 and 144 are detected after January 1, 1934, by the inspectors of the Mechanical Division and charge has been rendered against car owner, refund of the amount will be required in accordance with Interchange Rule 124.

Supply Trade Notes

THE SCULLIN STEEL COMPANY, St. Louis, Mo., will resume operations in its plant on February 8 with a force of 400 men. The plant was shut down on November 15.

S K F INDUSTRIES, INC., has moved its general and executive offices from New York to Front street and Erie avenue, Philadelphia, Pa.

THE HESS-BRIGHT MANUFACTURING COMPANY will be discontinued and all future trading will be done in the name of S K F Industries, Inc., Philadelphia, Pa.

W. H. TUCKER, who has been acting manager of the New York territory of the Vapor Car Heating Company, Inc., has been appointed eastern manager, with headquarters at 75 West street, New York.

J. V. HONEYCUTT has been appointed assistant general manager of sales and E. E. Goodwillie has been appointed assistant to the vice-president in charge of sales of the Bethlehem Steel Company, both with headquarters at Bethlehem, Pa.

F. A. SHICK has been appointed vice-president and controller, J. M. Larkin, vice-president in charge of industrial and public relations and C. R. Holton, vice-president in charge of purchasing of the Bethlehem Steel Company, all with headquarters at Bethlehem, Pa.

J. B. DURKEE has been appointed manager of the Houston, Tex., office of the A. M. Byers Company, Pittsburgh, Pa. Mr. Durkee formerly represented the company in the Houston territory and more recently in Tulsa, Okla. He succeeds H. B. Weathersby, who died on December 19.

S. M. D. CLAPPER has been elected president of the General Refractories Company, Philadelphia, Pa., succeeding John R. Sproul, who has resigned. Mr. Clapper had been chairman of the board of the company, which post is now vacated. Mr. Sproul also resigned as a director of the company and was appointed assistant to the president.

A MERGER of the Ambler Asbestos Shingle & Sheathing Company with the Keasbey & Mattison Company, both of Ambler, Pa., and the acquisition of a controlling interest in the latter company by Turner & Newall, Ltd., of Great Britain, has been announced by A. S. Blagden, president of the American companies. The enlarged business will retain the name of Keasbey & Mattison Company.

FRED P. BIGGS has been appointed assistant vice-president of the American Brake Shoe & Foundry Company, with headquarters at Chicago. Mr. Biggs entered the employ of this company in 1916 as a service engineer with headquarters at New York. During the World War he served as a military aviator both in this country and in France and at the conclusion of the war he resumed his duties as service engineer. In 1922 he was transferred to Chicago as salesman, which position he held until his appointment as assistant vice-president.

LUCIAN C. BROWN, vice-president in charge of sales of the Elwell-Parker Electric Company, Cleveland, Ohio, has resigned.

A. B. NILSEN, formerly with the late Fred K. Shults, New York, for nine years, has succeeded Mr. Shults with the Bettendorf Company, Bettendorf, Ia., and the MacLean-Fogg Lock Nut Company, Chicago, as sales representative for these companies in the eastern territory. Mr. Nilsen continues at the same address, Room 2043, Grand Central Terminal, New York City.

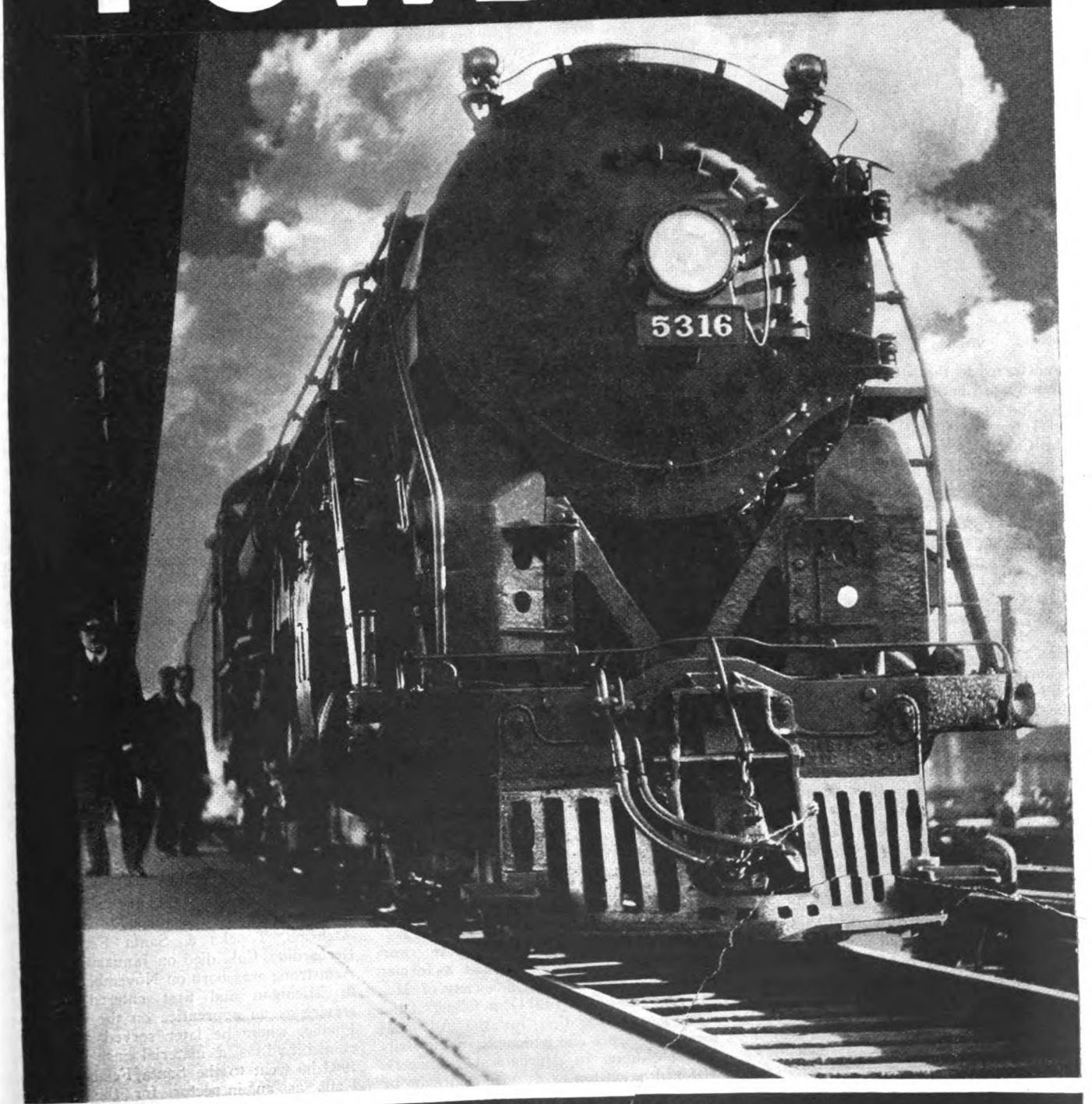
F. R. FAULK has been appointed Pittsburgh district representative for Universal arc welders, accessories and welding electrodes by the Universal Power Corporation, Cleveland, Ohio. His headquarters are at 50 Penn avenue, Pittsburgh, Pa. The Welding Equipment & Supply Company, 2720 East Grand Boulevard, Detroit, Mich., has also been appointed distributor for Universal arc welders, accessories and electrodes.

CLINTON L. BARDO, president of the New York Shipbuilding Company and formerly general manager of the New York, New Haven & Hartford, has been elected president of the National Association of Manufacturers, succeeding Robert L. Lund, who headed the association for two years; Mr. Lund was elected chairman of the board of the organization. Three new vice-presidents were chosen by the directorate as follows: George H. Houston, president of the Baldwin Locomotive Works, Philadelphia, Pa.; E. C. Heidrich, Jr., president of the Peoria Cordage Company, Peoria, Ill., and Charles R. Hook, president of the American Rolling Mills Company, Middletown, Ohio.

JOHN H. TRENT has been elected vice-president of the Johns-Manville Sales Corporation, with headquarters at New York. Mr. Trent was previously general sales manager in charge of the transportation and government sales. He was born in Meade County, Ky., and was educated in the public schools of Paducah, Ky. In 1901, he entered the service of the Illinois Central and after serving in the mechanical and stores departments of the Burnside shops, Chicago, he became storekeeper at Water Valley, Miss., subsequently serving at Memphis, Tenn., and Paducah, Ky. Mr. Trent has been associated with the Johns-Manville Sales Corporation and its predecessors for over 25 years, having served as sales manager of the western region with headquarters at Chicago, prior to his appointment as general sales manager in charge of the entire sales of the Transportation and Government departments, with headquarters at New York. Mr. Trent in his capacity as vice-president will be in charge of all functions of the Transportation department in the United States and Canada embodying steam railroads, electric railway, motor bus and aviation divisions.

(*Turn to next left-hand page*)

POWER!



The Locomotive Booster supplies power you can get in no other way because it capitalizes idle weight and spare steam.

FRANKLIN RAILWAY SUPPLY COMPANY, INC., NEW YORK, CHICAGO, MONTREAL

WILLIAM I. HOWLAND, JR., assistant general manager of sales of the Illinois Steel Company, Chicago, has been elected vice-president and general manager of sales, to succeed Edwin S. Mills, who has resigned in the interest of his health. Mr. Howland graduated from Yale university in 1908, with the degree of mechanical engineer, and in the same year entered the employ of the Illinois Steel Company in the operating department. He was later



William I. Howland, Jr.

transferred to the sales department, where he remained until 1916, when he was placed in charge of sales of alloy and electric steel for the Illinois Steel Company and the Carnegie Steel Company. In 1917, he entered the United States Navy and in 1919 returned to the employ of the Illinois Steel Company as assistant sales manager in the bar department. On December 1, 1926, he was promoted to the position of assistant general manager of sales of bars, strips and alloy steels, which he held until his recent election.

Mr. Mills was born at New Britain, Pa., on January 5, 1870, and in 1895 entered the employ of the Carnegie Steel Company as manager of sales at Cleveland, Ohio. Subsequently, he was general manager of the Pittsburgh Steamship Company, agent of the Oliver Iron Mining Company, and assistant to the first vice-president of the United States Steel Corporation at New York. From 1910 to 1919 he served as special sales agent of the Carnegie Steel Company and in the latter year was appointed general manager of sales of the Illinois Steel Company. Mr. Mills served also as manager of [illegible] Carnegie Steel Company, manager of sales of the [illegible] and the Tennessee Coal, Iron & Railroad Company. In 1926 he was elected vice-president and general manager of sales of the Illinois Steel Company.

Obituary

ROY J. COOK, who retired in 1931 as president of the Keyoke Railway Equipment Company, Chicago, died suddenly on January 17.

GEORGE J. MARTIN, eastern representative of the Union Asbestos & Rubber Company and the Equipment Specialties Company, with headquarters in New York, died in that city on January 16.

SAMUEL M. HINDMAN of the Schaefer Equipment Company, Pittsburgh, Pa., died on January 2, after a long illness at the age of 61 years.

J. P. BOURKE, vice-president of the Ewald Iron Company, Inc., at New York, died suddenly of a heart attack on January 17, at his home in Larchmont, N. Y.

WILLIAM BANCROFT POTTER, for many years engineer of the General Electric Company's railway department, died on January 15 at his home in Schenectady, N. Y.

JAMES HARTNESS, until last year president of the Jones & Lamson Machine Company, and formerly governor of Vermont, died at his home at Springfield, Vt., on February 3, after several months' illness. Mr. Hartness was born at Schenectady, N. Y., on September 3, 1861. He attended the public schools in Cleveland, Ohio, and was governor of Vermont for one term, 1921-23. While he never went to college, he received from the University of Vermont honorary degree of doctor of laws and master of engineering, the former in 1910 and the latter in 1921, and from Yale, in 1914, the degree of master of arts. Mr. Hartness had patents for more than 100 inventions, among them the Hartness flat turret lathe, Hartness automatic die, and Hartness screw-thread comparator. He became associated with the Jones & Lamson Machine Company in 1888, serving consecutively as superintendent, manager and president. He was Federal food ad-



James Hartness

ministrator for Vermont during the World War and a member of the commission that represented the United States at the Inter-Allied Aircraft Standardization Conference at London and Paris. At the same time he was chairman of the Committee on Public Safety for Vermont. After his term as governor Mr. Hartness succeeded President Hoover as president of the American Engineering Council. He was a former president of the American Society of Mechanical Engineers (1914), a fellow of the American Association for the Advancement of Science and a member of the British Institution of Mechanical Engineers. He had served also as vice-chairman of the Congressional Screw Thread Standardization Commission and was the author of "Machine Building for Profit" and "The Human Factor in Works Management." He was the recipient of the John Scott medal, given by the American Philosophical Society, for useful invention, and the Edward Longstreth Medal by the Franklin Institute of Philadelphia.

Personal Mention

General

FREDERICK E. LYFORD, special engineer to the executive vice-president, and more recently special engineer to the superintendent of motive power of the Lehigh Valley, has resigned and has been appointed an examiner for the Railroad Division of the Reconstruction Finance Corporation, with headquarters at Washington, D. C. Mr. Lyford will be a member of the staff of J. W. Barriger, chief examiner of the Railroad Division, and his principal duties will be field investigation of equipment and shop conditions, mechanical practices and related subjects in connection with comprehensive studies being made of railroads in the hands of receivers or trustees, to which R. F. C. loans have been made. Mr. Lyford was born on January 20, 1895, and was graduated in mechanical engineering from Cornell University. After a year in the service of a shipbuilding concern and a machine tool company, he entered the army, serving in the field artillery and in the air service in France as first lieutenant. In 1919 he became assistant sales manager of the Allied Machinery Company of America at New York, which position he resigned in the following year to engage in advertising and sales promotion work for a milling company at Waverly, N. Y. In 1923 he entered the service of the Lehigh Valley as apprentice instructor and also directed classes for the instruction of mechanical department foremen. Subsequently he served as assistant general machine foreman at the Sayre locomotive shops of the Lehigh Valley, during which period he also handled engineering matters for the shop superintendent. Thereafter he was promoted to special engineer to the executive vice-president, in which capacity he made special studies of a wide variety of subjects connected with mechanical department questions, including feedwater heating, water treatment, locomotive lubrication and the design and economy of new motive power.

WILLIAM DONOHUE has been appointed acting master mechanic of the Southern Pacific Lines in Texas and Louisiana, with headquarters at Ennis, Tex.

Obituary

ALEXANDER G. ARMSTRONG, superintendent of shops for the Coast Lines of the Atchison, Topeka & Santa Fe, at San Bernardino, Cal., died on January 12. Mr. Armstrong was born on November 4, 1872, in Michigan and first entered railway service as an apprentice on the Northern Pacific, where he later served as a machinist and as a material inspector. In 1903 he went to the Santa Fe at Topeka, Kan., as an inspector for the Baldwin Locomotive Works, later being appointed a foreman in the Santa Fe shops at San Bernardino. In 1911 he was promoted to the position of division foreman at Los Angeles, Cal., and in 1913 became master mechanic at Needles, Cal. Subsequently Mr. Armstrong was transferred to San Bernardino where he was appointed superintendent of shops in March, 1918.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

March, 1934

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices,
30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: Terminal Tower
Washington: 832 National Press Bldg.
San Francisco: 58 Main St.

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Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States and possessions: 1 year, $3; 2 years, $5. Canada, including duty: 1 year, $3.50; 2 years, $6. Foreign countries: 1 year, $4; 2 years, $7.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.



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Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

March - 1934

What Price Air Conditioning?

By L. J. Verbarg*

Wide adoption of air conditioning makes consideration of factors for determining most suitable system essential

A DECISION as to the type and style of air conditioning apparatus best suited for railway cars operating under the diverse conditions found on our many railways is of increasing importance as the number of such trains is increased.

Due to the fact that air conditioning of railway cars is in the development stage, most existing installations have been made without proper regard to operating efficiency, the chief aim being to get the cars into service without delay to meet some competitive condition. Insufficient consideration has been given to the refrigerant used, efficiencies of motors, compressors, condensers, etc., design of air ducts, or whether duct or bulkhead distribution of air is more desirable.

Most purchases of air-conditioning equipment have been made on the claims of manufacturers as to performance of their equipment, because of the lack of facilities or reliable data with which to check these claims. The selection and application of equipment in this manner may be fairly satisfactory when only a few cars are to be air conditioned, but as the number of cars increases this procedure does not give the desired result. Eventually the operating and maintenance cost as well as performance is sure to be checked and the engineer charged with the design and installation of air-conditioning equipment will be wise to analyze the problems carefully before equipment is purchased and installed and to make recommendations according to the facts developed in his analysis.

Most cars being air conditioned today were built before manufactured weather became a reality, and to change their construction to provide adequate insulation would increase the cost of the installation to a prohibitive amount; therefore, the engineer must take the car "as is" and in some way find space for the equipment and provide sufficient refrigerating capacity to overcome the lack of insulation.

Air conditioning is defined as the complete control of temperature, humidity, motion and cleanliness of air within an enclosure, regardless of outside conditions. Therefore, it is necessary to provide apparatus that will add heat when desired in the cold season and abstract it during the warm season, also control the humidity, circulate and wash the air.

Four distinct temperatures are considered in air-conditioning calculations. *Dry-bulb temperature* needs no explanation as it is well understood as indicating heat intensity. *Wet-bulb temperature* is the temperature to which air will cool itself to the saturation point when undergoing a constant heat change in the presence of freely evaporating, non-cooled, non-heated water. The difference between dry and wet bulb is known as the "wet-bulb depression." *Dew point* is the temperature at which vapor begins to condense out of the air. The difference between dry bulb and dew point is known as the "dew-point depression." When air is saturated these three temperatures are the same, but as we depart from saturation both the wet-bulb depression and the dew-point depression increase. *Effective temperature* is a combination of temperature and humidity and is the temperature which affords the greatest degree of comfort to the human body.

The last important factor in air-condition calculations is humidity. Relative humidity is the ratio of moisture actually present in the air at its dry-bulb temperature to that which would be present if the air were saturated at its dry-bulb temperature. The relations between dry bulb, wet bulb and relative humidity have been plotted into curves known as psychrometric tables. If any two of these factors are known, the third may be ascertained from the tables.

The importance of humidity control is apparent by consulting the effective temperature chart, Fig. 1. This chart was prepared by the Harvard School of Public Health. It will be noted that the summer effective temperature ranges from 68 deg. F. at 70 per cent relative humidity to 85 deg. F. at 30 per cent relative humid-

* Supervisor of power plants, Missouri Pacific Lines.

ity. While 85 deg. with 30 per cent relative humidity is regarded as comfortable, the same temperature with 70 per cent relative humidity is far outside the comfort zone. Winter effective temperatures range from 65 deg. F. at 70 per cent relative humidity to 79 deg. F. at 30 per cent relative humidity. Any temperature or humidity condition within these limits is regarded as being in the comfort zone. One set of temperature and relative humidity conditions will not, however, provide an equal degree of comfort for all persons. A summer effective temperature of 76 deg. is well within the comfort zone, yet it is often regarded as too warm by some of the traveling public, particularly those from a northern climate. It must be remembered that the adjustment of the human body from one temperature to another is a rather slow process; therefore, the temperature maintained in air-conditioning work must bear some relation to outside temperature conditions. The best we can strive for in the design of air-conditioned cars is the satisfaction of the majority of the traveling public.

Refrigerating Capacity Required

Experiments recently conducted indicate that to provide an interior effective temperature within the comfort zone it is necessary to remove heat from various classes of cars at the following rate:

	B.t.u. per hr.
Diners (capacity, 40 persons)	64,000 to 70,000
Lounge cars	65,000 to 80,000
Dining-lounge cars	65,000 to 70,000
Chair-coach	65,000 to 75,000

Using a modern steel diner as an example, the total amount of heat to be abstracted may be traced to the following sources:

		B.t.u. per hr.
1.	Heat infiltration through walls insulated with two-ply salamander	11,000
2.	From human bodies (40 people)	18,000
3.	From food	3,000
4.	From fresh air and dehumidification	24,000
5.	From solar radiation	10,000
6.	From fan motor	750
	Total	66,750

The above is based on an outside temperature of 90 deg. F. Any departure from this temperature will have a slight effect on items 1 and 4. Regarding item 2—heat from human bodies—the human body, like a partly wetted wet-bulb thermometer, does not react in direct relation to either a dry-bulb or a wet-bulb thermometer under normal conditions. When subjected to extreme temperature the regulatory system throws out perspiration to the extent that the saturation may become practically complete. The body, however, differs in one respect from the wet-bulb comparison in that it is internally heated. Food is converted by oxidation into energy which is utilized for external work or internal reconstruction. This process of metabolism is not 100 per cent efficient; therefore, waste heat is created and unless dissipated will cause body temperature to increase. It is a function of air-conditioning systems to absorb this waste heat at the rate it is dissipated from the body, which is about 450 B. t. u. per hr. for a person of average size. Having determined the total amount of heat to be abstracted per hour, it is necessary to divide this figure by 12,000 to obtain the refrigeration tonnage required.

Refrigerating machinery is rated in tons of refrigeration per 24-hr. period, but the temperature at which this refrigeration is produced is a vitally important factor in air-conditioning calculations. Fig. 2 shows the effect of temperature on the capacity of the refrigerating equipment.

Heat absorption by the evaporator is governed entirely by its temperature and the velocity of the air passing through it. This rate of heat absorption must always be equal to or below the capacity of the refrigerating unit to avoid overloading. The relative humidity obtainable inside the car with any type of refrigerating equipment depends largely upon the evaporator temperature, and to provide satisfactory humidity conditions the cooling coil or evaporator temperature must remain below the dew point. It is, therefore, apparent that a unit rated at 60 deg. F. might prove satisfactory when used in sections of the country that have consistently high dew points, but would be entirely inadequate to control the humidity where the dew point is consistently low.

Types of Refrigerating Equipments

There are three distinct types of refrigeration available and the final choice depends largely upon the conditions under which the car is to operate.

Many engineers advocate the natural ice system because of its simplicity, ease of installation, absence of chemical refrigerant and low first cost. These advantages are offset by the space requirements for ice bunkers, the necessity of providing icing facilities en route if the car is assigned to a long run and a relatively high operating cost. Maintaining a refrigerating rate of six tons requires the melting of 500 lb. of ice per hour. As ice storage capacity is limited to a maximum of 4,500 lb. of ice per car, the time between icing would be nine hours at most. Based on an average speed of 40 m.p.h., the car would have to be re-iced every 360 miles and probably more often, as the refrigeration decreases as the amount of ice in the storage bunkers decreases.

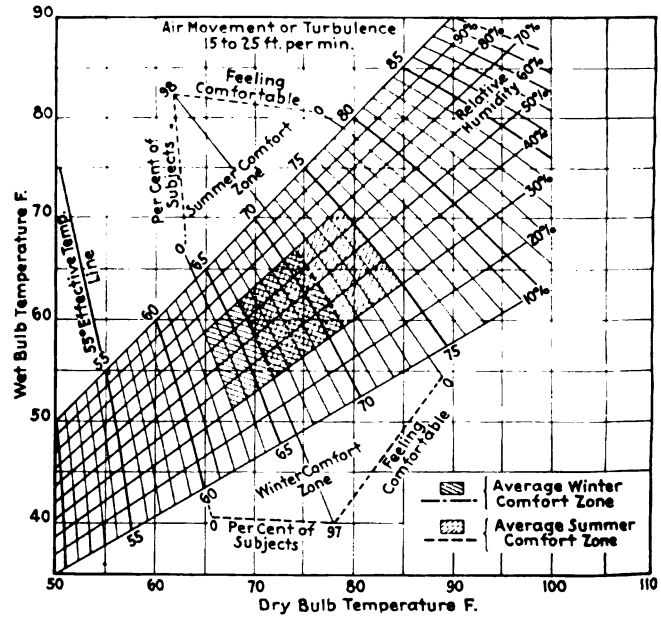


Fig. 1—Comfort or effective temperature chart

At present a large percentage of air-conditioned cars are equipped with mechanical type refrigeration. The success of this type of equipment is a matter of power supply and rigid maintenance. The mechanical system falls into two classes, one having the compressor electrically driven and the other with the compressor mechanically driven direct from the car axle.

The compressor in the latter type is usually driven through a series of V-belts and the speed control is obtained by interposing a magnetic clutch in the drive shaft. With this equipment no refrigeration is available while the car is standing and only partial capacity is obtainable until the car reaches a speed of approximately 30 m.p.h.

A system of this type would be desirable only when the car is to be assigned to trains on which stops are infrequent and of short duration. Fig. 3 shows the temperature rise in a dining car after refrigeration has been discontinued. In addition to the rapid temperature rise water is re-evaporated off the cooling coils, thus raising the relative humidity inside the car enough to make it extremely uncomfortable after refrigeration has been discontinued 15 min. or longer. On equipment driven directly from the car axle an a. c. motor is provided to drive the compressor during precooling periods, but this source of power is seldom available during station stops and not at all during switching movements. The chief advantage claimed for this equipment is that it eliminates the necessity of providing large generators and high-capacity batteries.

With the electrically driven compressor type equipment refrigeration is available whether the car is moving, standing or being switched. Power is supplied from a 32-volt storage battery during station stops and switching movements, and an a. c. motor is provided to drive the compressor during precooling periods. Another advantage claimed for the electrically driven equipment is that it is independent of any source of power not contained on the car itself.

All makes of compressor-type refrigerating units are essentially alike, although they differ as to the size and number of cylinders, compressor speed, etc. Most equipments rely on air to cool the compressor and condense the refrigerant, although several manufacturers can supply water-cooled units if desired. Water-cooled equipment operates at lower head pressures than the air-cooled style and naturally less compressor power is required. This is offset by the power required to operate

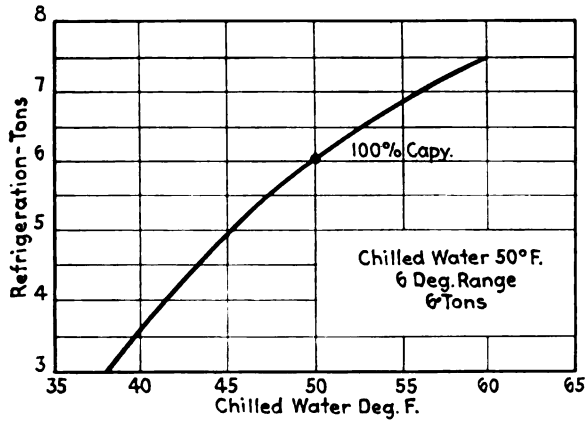


Fig. 2—Effect of temperature on capacity of refrigerating equipment

the water pump and cooling tower equipment and the fact that the water supply must be replenished frequently to compensate for loss by evaporation.

With most electrically driven equipments the compressor motor can be converted to a d. c. generator when the equipment is driven by the a. c. motor, and the current thus generated is available for the battery charging during the precooling period.

The third type of equipment available is the steam-jet or thermal compressor system, using water as a refrigerant and locomotive steam to produce the refrigerating effect. While this method of refrigeration has been used for more than 20 years, only recently has it become a commercial success on passenger-train cars. Artificial reduction of the pressure on water makes it boil at a point below the normal boiling point. If the air is exhausted from a vessel until the pressure is only 0.085 lb. per sq. in., water within the vessel will boil at 32 deg. F. In other words, the temperature at which water ordinarily freezes now becomes its boiling point. Steam-jet refrigeration uses this principle. The refrigerating chamber or evaporator is an air-tight metal container, about one-fifth of which is filled with water. The space above the water is evacuated until the pressure is less than 1 in. of mercury per sq. in. This evacuation is accomplished by a steam jet through which the steam rushes past an opening in the evaporator at a velocity of from 3,500 ft. to 4,500 ft. per sec. At the top of the evaporator is a horizontal pipe through which water is sprayed into it. Because of the extremely low pressure in the evaporator these sprays immediately flash into vapor. As the latent heat of evaporation at this pressure is approximately 1,060 B.t.u., the transformation of each pound of water into vapor requires this amount of heat. With no other source from which to obtain this heat other than the water in the bottom of the evaporator, this water is cooled to the temperature corresponding to the pressure maintained in the cooling chamber. The vapor is carried along by the steam jet and as it passes through the narrow throat of the jet is compressed. It then passes through the condenser, which is usually of the surface type. This condenser is generally cooled by the action of water sprays and air. After the water in the evaporator is chilled to the desired temperature, it is pumped through the cooling coil where its temperature is raised by the absorption of heat in the air passed over the coil. The water is then returned to the evaporator and the process repeated.

With cars so equipped it is necessary to have some external source of steam to operate the air-conditioning apparatus while cars are being pre-cooled at terminals. This constitutes a disadvantage, as in most terminals steam is not available during that season of the year when precooling is desirable. Also, no refrigeration is available during switching operations when the cars are disconnected from the locomotive.

Power Requirements

An investigation of power requirements for motor-driven compressor equipments now on the market reveals that there is little difference in the kilowatt input required per ton of refrigeration delivered. This input ranges from 2.01 kw. to 2.10 kw. per actual ton of refrigeration at 40 deg. evaporator temperature, the average being 2.06 kw.

Recent tests on two identical cars operating in the same territory—one equipped with a six-ton mechanical unit and the other with a six-ton steam-ejector unit—showed the following comparison of power required:

	Mechanical	Steam Ejector
Continuous input for refrigerating equipment, in kw.	8.4	3.1
Continuous input for battery recharging, in kw.	2.8	1.0
Average output of generator, in kw.	11.2	4.1
Generator efficiency	80 per cent	
Generator drive efficiency	90 per cent	
Locomotive mechanical efficiency	80 per cent	
Locomotive steam consumption, i.hp.hr.	20 lb.	
Time of train run	9 hr. 55 min.	
Time refrigeration required	9 hr. 55 min.	
Time generator in operation	7 hr. 27 min.	
Total generator output required	86.76 kw. hr.	30.69 kw. hr.
Total hp. input to locomotive cylinders	202 hp. hr.	71.5 hp. hr.
Average locomotive steam used per hr. of generator operation	542 lb.	192 lb.
Steam used by ejector, per hr.	...	200 lb.
Steam loss by condensation, per hr.	...	30 lb.
Total steam to cylinders	4,040 lb.	1,430 lb.
Avg. cylinder i.hp. per hr. of generator operation	27.1	9.6
Avg. steam used per hour of train run	408 lb.	374 lb.
Total steam used	4,040 lb.	3,709 lb.

When measured in terms of total steam consumption there is little difference in the amount of power required,

but it is evident that with the mechanical system all this power must be developed by the locomotive cylinders, while the majority of the power required for the steam-ejector system is furnished direct from the locomotive boiler. This fact is relatively unimportant when only one or two cars in a train are equipped, but the equipping of solid trains of ten or more cars with motor-driven compressor type equipments would impose such an additional load on the locomotive cylinders that it is doubtful whether present schedules could be maintained without reducing train tonnage. The additional load imposed on the locomotive cylinders by the mechanically equipped car under test was equivalent to the load which would have been imposed moving 36.2 train tons at 40 m.p.h. The additional cylinder load imposed by the steam-ejector system was equivalent to moving 12.85 tons at 40 m.p.h. The amount of steam required by the ejector is furnished direct from the locomotive boiler and is about the same amount of steam that is required to heat a car in zero weather.

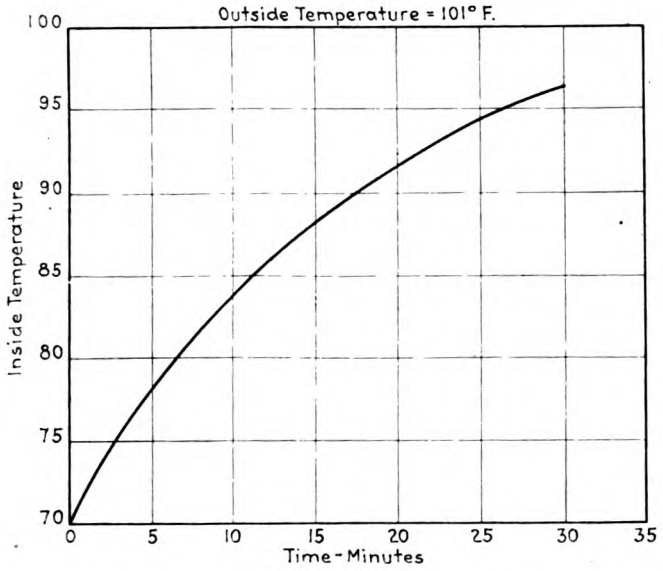


Fig. 3—Temperature rise after discontinuance of refrigeration

Refrigerants

All compressor type refrigerating units depend upon a manufactured chemical refrigerant for their refrigerating cycle. For general commercial refrigerating work ammonia is most widely employed, but carbon dioxide, sulphur dioxide, methyl-chloride, ethyl-chloride and several other special compounds have been used. All these refrigerants are more or less toxic, while some have a pungent odor and are decidedly distressing and damaging to the human organism. Because of the toxic qualities of the refrigerants mentioned none of them is suitable for use in air-conditioning systems, and it became necessary with the advent of air conditioning to develop a non-toxic refrigerant whose refrigerating cycle could be completed under ordinary temperatures and pressures. The result of this development was a gas known as dichlorodifluoromethane ($C\ Cl_2\ F_2$). This gas is commonly known as F-12 or Freon. Certain other derivatives of this gas have been obtained and are known as F-11 and F-114. Although these derivatives of F-12 are useful in absorption systems and small household units, F-12 is better adapted for use on railway cars. Although Freon is difficult to keep confined in a refrigerating system and its cost is high, nearly all manufacturers of air-conditioning apparatus now recommend its use.

Air Ducts

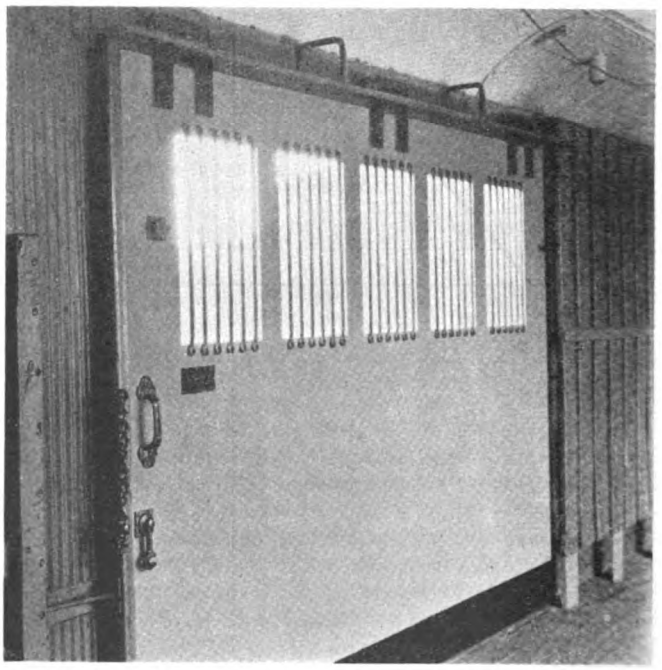
The design of air ducts is of great importance as their design affects the air distribution in the car and to some extent the outlet temperature of the chilled air. The ducts should be well insulated from solar radiation and also from the steel car roof. The use of aluminum foil for insulation of air ducts seems practical, as this form of insulation is light in weight, easy to apply and has an exceptionally high efficiency. Experiments are now being conducted to determine the effect of aluminum paint as a reflecting agent to reduce the heat from solar radiation.

Control Lockers

The ventilation of control lockers is of prime importance. The natural draft method used on ordinary car-lighting control lockers has proved inadequate to dissipate the heat generated by the control apparatus of air-conditioning equipment of the mechanical type, and lockers used for this purpose should be equipped with some type of forced ventilation.

Baggage Car Doors

THE accompanying illustration shows an installation of a Phemaloid Compound Lumber door in a baggage car. These doors, manufactured by the Haskelite Corporation, Chicago, were made from a single piece of Phemaloid lumber. Phemaloid is made of real wood, cross laminated for strength and glued with a phenolic resin adhesive which is said to be immune to moisture and bacteria growth—the principal causes of rot. The particular installation shown was one of four car doors, two 8 ft. 1½-in. by 6 ft. 2¼-in. and two doors 6 ft. 1½-in. by 6 ft. 2¼-in. All four doors in this car were 1½-in. thick.



Phemaloid compound lumber door as applied to Pere Marquette baggage car

Locomotive Counterbalancing

By Lawford H. Fry

This is the Appendix to the author's A. S. M. E. paper which appeared in the February issue. It contains a schedule of simple computations by which the results set forth in the paper may be obtained

THE principles of the method and the results to be obtained are discussed in the body of the paper. This schedule is drawn up to present the detailed methods of computation to be followed in order to secure the results desired. Values corresponding to an actual locomotive are inserted for each item and the schedule is arranged so that if it is re-written with blank spaces for the values it can be used as a work sheet for computing any other example.

The notes at the end of each section define any special terms used and provide any necessary discussion of the methods.

The data as to weights and dimensions called for by the schedule must, of course, be obtained from the design of the locomotive.

Section I—To Find the Equivalent Weight and Plane of Action of the Rotating Parts in Each Wheel

The schedule given here is drawn to cover the main pair of driving wheels. It should be applied successively to each of the other pairs of drivers, dropping out the items which do not apply. This section of the schedule is illustrated by Figs. 5 and 6.

1. E = Distance in inches between central planes of right and left hand counterbalances ..... 62 in.
2. W_1 = Equivalent weight in pounds of crank pin hub together with part of pin encircled by hub ..... 500 lb.
3. A = Distance in inches between centers of gravity of right and left hand crank pin hubs ..... 71 in.
4. M_1 = Moment of crank pin hub parts about center plane of opposite counterbalance.
   $M_1 = W_1 \times (A + E) \div 2$ ..... 33,200 in./lb.
5. W_2 = Equivalent weight in pounds of side rod carried on crank pin* together with weight of part of crank pin encircled by side rod bearing ..... 550 lb.
6. B = Distance in inches between center planes of side rods ..... 77 in.
7. M_2 = Moment of side rod parts about center plane of opposite balance.
   $M_2 = W_2 \times (B + E) \div 2$ ..... 38,200 in./lb.
8. W_3 = Equivalent weight in pounds of back end of main rod* together with weight of part of crank pin encircled by main rod bearing ..... 1,440 lb.
9. C = Distance in inches between center planes of main rods ..... 85 in.
10. M_3 = Moment of main rod parts about center plane of opposite counterbalance.
    $M_3 = W_3 \times (C + E) \div 2$ ..... 106,000 in./lb.
11. Wt = Sum of all rotating equivalent weights, except those for eccentric cranks.
    Wt = Items (2 + 5 + 8) =
    $W_1 + W_2 + W_3$ ..... 2,490 lb.
12. Mt = Sum of all moments of rotating parts, except eccentric cranks, about center plane of opposite counterbalance.
    Mt = Items (4 + 7 + 10) =
    $M_1 + M_2 + M_3$ ..... 177,400 in./lb.
13. F = Distance in inches between center of gravity of all rotating parts, except eccentric cranks, and center plane of opposite counterbalance.
    F = Item 12 / Item 11
    = Mt ÷ Wt ..... 71.3 in.

* See Notes on Section 1.

Notes on Section I

Item 2—To find the equivalent weight of the crank pin hub together with the part of the pin encircled by the hub, it is necessary to find the actual weight of these parts and their center of gravity. The weight to be taken into account is that of the cross-hatched area in Fig. 6 which lies outside the circumference of the axle hub. Then if

W = Actual weight of these parts in pounds.
R_1 = Distance in inches of their center of gravity from longitudinal axis of axle.
R = Radius of rotation of crank pin in inches.
W_1 = Equivalent weight of these parts
$W_1 = W \times R_1/R$

Equivalent Weight of any part rotating about the longitudinal center line of the axle is defined as the weight of that mass which rotating at the crank radius would produce the same inertia force as the actual mass under consideration. The above example shows how the equivalent weight is found when its actual weight and the radius of rotation of its center of gravity are known.

Item 5—The equivalent weight of the side rod carried on the crank pin is the actual weight supported by the pin. For the front and back drivers this is the weight of one end of one side rod. For the main and intermediate drivers it is the weight of one end of each of two rods. As the center of gravity of the side rod end

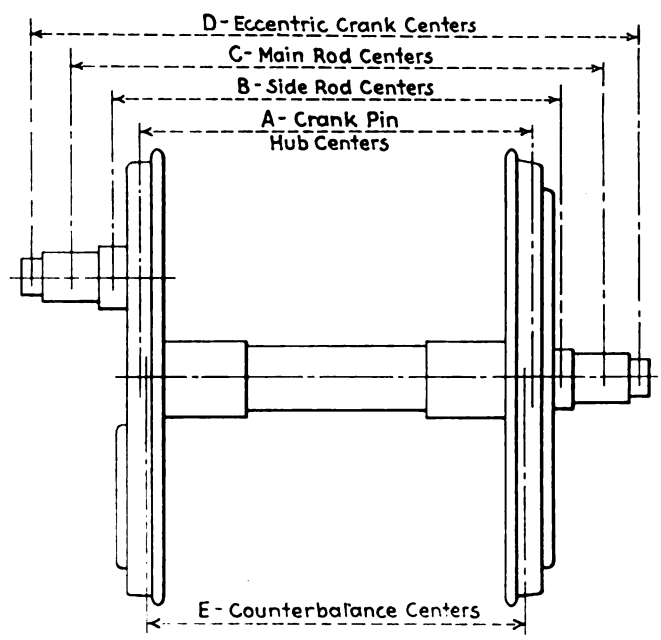


Fig. 5—Data for computation of effect of rotating parts

rotates with the same radius as the center of the crank pin, the equivalent weight of these parts is the same as their actual weight.

Item 8—The equivalent weight of the back end of the main rod to be used in this item can be taken as approximately six-tenths of the total weight of the main

rod. If strict accuracy is required the weight to be used can be found from the equation:

$W_{ms} = W_m \times k^2/l^2$

where W_m = total weight of main rod in pounds.
l = length of rod in inches between wrist pin and main pin centers.
k = radius of gyration in inches of the main rod about the wrist pin center.
W_{m_2} = weight of main rod to be considered as rotating at the crank pin.

The radius of gyration k can be found by suspending the

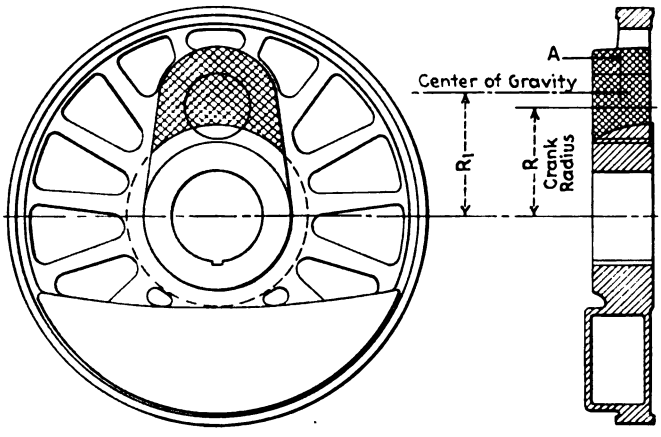


Fig. 6—Portion of crank-pin hub to be included in revolving weights

main rod to swing as a pendulum about the wrist pin center. Then if

k = distance in inches of the center of gravity of the rod from the wrist pin center

and

t = time of one swing in seconds

$k^2 = 3.26\ t^2k$.

If the radius of gyration k cannot be found experimentally, and if the main rod is of normal design, a reasonably close approximation can be obtained by assuming a value of 0.6 for $k^2 \div l^2$. The equivalent weight of the back end of the main rod is then six-tenths of the total weight.

$W_{m2} = 0.6 \times W_m$.

Section II — To Resolve the Equivalent Weight of the Rotating Parts on One Side of a Pair of Wheels into Two Components, One in the Wheel carrying the Rotating Parts and the Other in the Opposite Wheel of the Pair

This section is illustrated by Fig. 1 (a) and (b). Items which are taken from Sec. 1 are given the same number here.

11. W_t = Total equivalent weight of rotating parts (Sec. 1)....2,490 lb.
13. F = Distance in inches from center of gravity of rotating parts to center plane of opposite counterbalance. (Sec. 1).....71.3 in.
1. E = Distance between center planes of counterbalances. (Sec. 1) .....62.0 in.
14. W_l = Component of left hand rotating parts acting in center plane of left counterbalance.
$W_l = W_t \times F \div E$.....2,870 lb.
15. W_r = Component of left hand rotating parts acting in center plane of right counterbalance.
$W_r = Wl - W_t$.....380 lb

Section III — To Determine the Inertia Effect of the Eccentric Cranks

Fig. 7* shows the relative positions of the eccentric cranks. The center of gravity of each crank does not lie on the main crank radius. The crank cannot, therefore, be accurately represented by a single equivalent weight acting along the main crank radius. Each crank must be represented by two equivalent weights acting, one along the crank radius, the other along a radius 90 deg. ahead of this. This is illustrated by the isometric diagram in Fig. 8. In this, each eccentric crank is represented by two equivalent weights in the plane of rotation of the center of gravity of the eccentric crank. These four equivalent weights must be replaced by four others, two acting in each counterbalance plane. These are computed as follows:

16. W_e = Actual weight in pounds of one eccentric crank, together with weight of part of crank pin encircled by eccentric crank .....172 lb.
17. b = Length in inches of intercept of center of gravity of eccentric crank on crank radius (See Fig. 7).....10.4 in.
18. a = Length in inches of intercept of center of gravity of eccentric crank on radius 90 deg. ahead of crank.....3.15 in.
19. D = Distance in inches between centers of gravity of eccentric cranks (Fig. 8).....91 in.
1. E = Distance in inches between the center planes of counterbalances .....62 in.
R = Crank radius in inches.....15 in.

From these data are computed the component equivalent weights which, acting in the planes left and right hand counterbalances, represent completely the inertia effects of the eccentric cranks.

In Left-Hand Counterbalance Plane

20. Leb = Component equivalent weight acting along crank radius
$= \frac{We}{2RE} [b(D + E) + a(D - E)]$.....156 lb.
21. Lea = Component equivalent weight acting along radius 90 deg. ahead of crank
$= \frac{We}{2RE} [a(D + E) - b(D - E)]$.....17 lb.

In Right-Hand Counterbalance Plane

22. Reb = Component equivalent weight acting along crank radius
$= \frac{We}{2RE} [b(D + E) - a(D - E)]$.....138 lb.
23. Rea = Component equivalent weight acting along radius 90 deg. ahead of crank
$= \frac{We}{2RE} [a(D + E) + b(D - E)]$.....73 lb.

The equivalent weights are not the same in the two counterbalance planes, although the resultant is the same

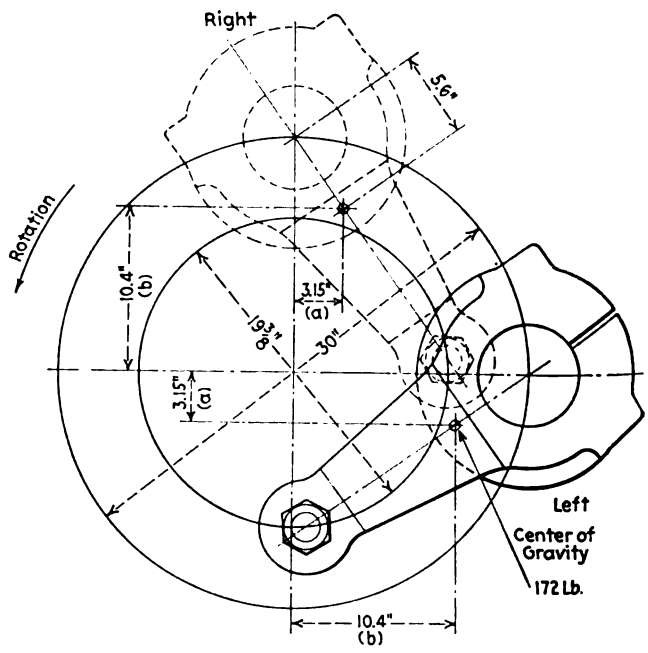


Fig. 7—Position of the eccentric cranks

in both planes. The reason for the lack of symmetry can be seen in Fig. 8. In the horizontal plane, through the main axle the 36 lb. component of the left eccentric and the 119 lb. component of the right eccentric both act in the forward direction. In the vertical plane, on the other

* The cranks are shown trailing. In Fig. 8 and the text, however, they are assumed to be leading the crank pins.

hand, the 119 lb. component of the left eccentric acts upwards, while the 36 lb. component of the right eccentric acts downwards.

Section IV — To Combine Inertia Effect of Eccentric Cranks and Other Rotating Parts

In Sections II and III the inertia effect of the other rotating parts and of the eccentric cranks have been resolved into equivalent weights acting in the center planes of the two counterbalances. The net effect of all the rotating parts is found by adding the values found in

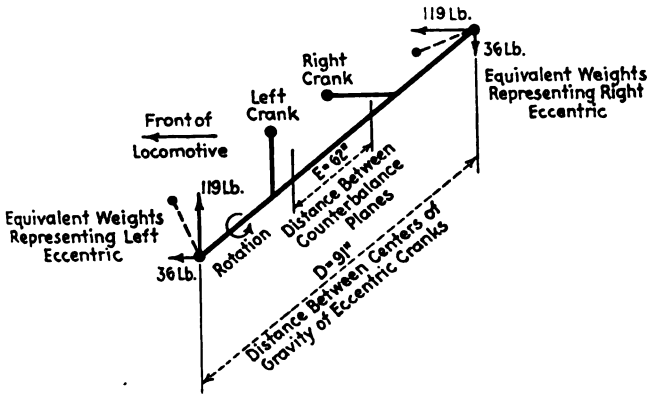


Fig. 8—Isometric diagram illustrating the replacement of each eccentric crank by two equivalent weights acting in the plane of rotation of the crank

the two preceding sections. The operation is illustrated by Fig. 9. The quarters of each wheel are numbered for convenience of reference.

In Left-Hand Counterbalance Plane
Diameter through Left Crank Pin:

14. W_l = Equivalent weight representing other rotating parts at quarter (1) ..... 2,870 lb.
20. Leb = Equivalent weight representing eccentric cranks at quarter (1) ..... 156 lb.
24. W'_1 = Net equivalent weight at quarter (1) ..... 3,026 lb.

Diameter perpendicular to Left Crank:

15. W_r = Equivalent weight representing other rotating parts at quarter (4) ..... 380 lb.
21. Lea = Equivalent weight representing eccentric cranks at quarter (2) ..... 17 lb.
25. W'_4 = Net equivalent weight at quarter (4) ..... 363 lb.

In Right-Hand Counterbalance Plane
Diameter through Right Crank Pin:

14. W_l = Equivalent weight representing other rotating parts at quarter (2) ..... 2,870 lb.
22. Reb = Equivalent weight representing eccentric cranks at quarter (2) ..... 138 lb.
26. W''_2 = Net equivalent weight at quarter (2) ..... 3,008 lb.

Diameter perpendicular to Right Crank:

15. W_r = Equivalent weight representing other rotating parts at quarter (3) ..... 380 lb.
23. Rea = Equivalent weight representing eccentric cranks at quarter (3) ..... 73 lb.
27. W''_3 = Net equivalent weight at quarter (3) ..... 453 lb.

Fig. 9 illustrates these operations. The figures are the same as in Fig. 1 (c). Items 24, 25, 26, and 27 give the four equivalent weights which, acting two in each counterbalance plane, completely represent the inertia effect of all rotating parts, including the eccentric cranks. Having these, it is a simple matter to complete the analysis of the wheels by adding the effect of the counterbalance as in Fig. 1 (e). The net equivalent weights representing counterbalances and all rotating parts are shown in Fig. 1 (f). Details of the operation are given in Section VII.

Section V — To Find the Position and Value of the Maximum Dynamic Axle Load when the Resultant Equivalent Weights Producing Dynamic Augment in the Wheels Are not the Same

This section is illustrated by Fig. 10

28. W_l = Resultant equivalent weight in pounds producing dynamic augment in left hand wheel ..... 138 lb.
29. W_r = Resultant equivalent weight in pounds producing dynamic augment in right hand wheel ..... 132.5 lb.
30. Z = Angle in degrees between planes in which the above equivalent weights act ..... 119 deg. 15 min.

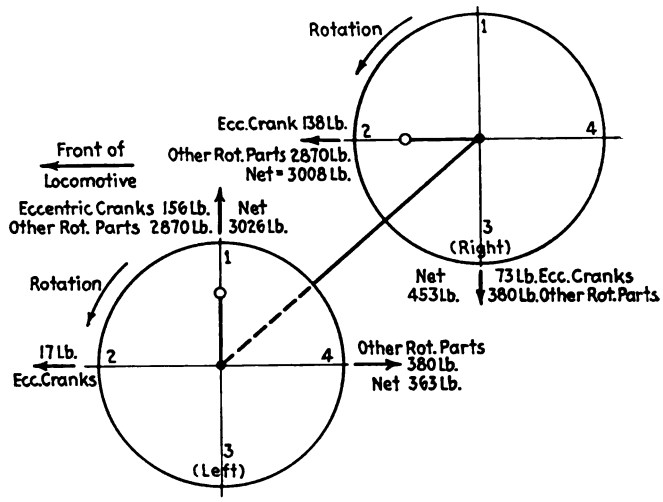


Fig. 9—Equivalent weights acting in center planes of counterbalances representing eccentric cranks and other rotating parts

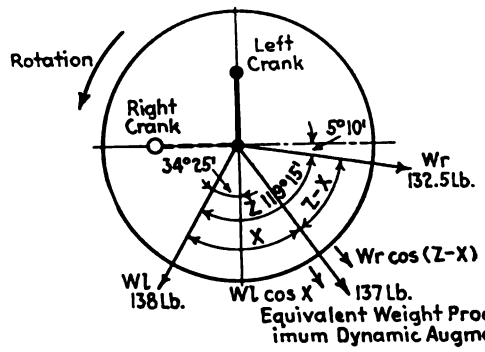


Fig. 10—Computation of maximum dynamic augment in axle when equivalent weights producing maximum dynamic augments in wheels have values Wl and Wr and stand at an angle Z from each other

Assume that in the position of maximum axle dynamic augment.

31. X = Angle in degrees between direction of left hand resultant and the vertical.

then

Z — X = Angle in degrees between the direction of right hand resultant and the vertical.

It follows that

$W_l \cos X$ = vertical component contributed by left hand resultant.

$W_r \cos (Z - X)$ = vertical component contributed by right hand resultant.

Then $W_l \cos X + W_r \cos (Z - X)$ is the total equivalent weight producing the maximum dynamic augment in the axle.

This has its maximum value when

$$\tan X = \frac{\sin Z}{W_l/W_r + \cos Z}$$

With the values given above for W_l, W_r, and Z, the value of X is found to be 57 deg. 40 min. Then the

total equivalent weight producing the maximum dynamic augment in the axle:

$$W_1 \cos X + W_r \cos (Z - X) = 138 \times 0.535 + 132.5 \times 0.476$$
$$= 74 + 63$$
$$= 137 \text{ lb.}$$

Section VI—Determination of Equivalent Weight and Position of Counterbalance To Exactly Balance the Rotating Parts and Provide a Given Over-balance for the Reciprocating Parts

This section is illustrated by Fig. 3. A blank diagram similar to Fig. 3 should be used, and the values should be filled in as described. In the following description the diagram is assumed to represent the left hand wheel of the pair and the quarters are numbered 1, 2, 3, and 4. Quarter No. 1 being that of the left hand crank pin.

24. W'_1 = Component of rotating parts acting in plane of left counterbalance at quarter (1); see Sec. IV.....3,026 lb.
25. W'_4 = Component of rotating parts acting in plane of left hand counterbalance at quarter (4); see Sec. IV..... 363 lb.
32. W_0 = Equivalent weight of over-balance to be added to oppose the reciprocating parts..... 66 lb.
[The value to be given this item may be chosen arbitrarily. The better plan is to determine it to hold the dynamic augment to a definite limiting value.]

33. W_{c3} = Component of counterbalance to act in quarter (3), opposite the crank pin = Item 24 + Item 32.....3,092 lb.
34. W_{c2} = Component of counterbalance to act in quarter (2). $W_{c2} = W'_4$..... 363 lb.
35. W_c = Resultant equivalent weight of counterbalance to produce the components shown in quarters 3 and 4 in Fig 3 (b)

$$W_c = \sqrt{W_{c3}^2 + W_{c2}^2} \text{.....3,113 lb.}$$

36. a = Angle which radius through center of gravity of counterbalance makes with the diameter through quarters 1 and 3.

$$\tan a = W_{c2}/W_{c3} = 363/3092$$
$$= 0.1275$$
$$a = 6 \text{ deg. } 42 \text{ min.}$$

The equivalent weight and position of the counterbalance thus determined are shown in Fig. 3 (c)

In designing the actual counterbalance to have this equivalent weight proper allowance must be made for the equivalent weight of the spokes and rim adjacent to the crank-pin hub which occupy the space corresponding to the space covered by the counterbalance in the opposite quarter of the wheel. The counterbalance determined by Items 35 and 36 will exactly cross-balance the reciprocating parts, and the only unbalanced mass producing dynamic augment will be the over-balance of equivalent weight W_0 acting in quarter (3) directly opposite the crank pin.

It may be noted that it is important to cross-balance when the value of W_r, the component due to the rotating parts of the opposite wheel, is large compared with W_0, the over-balance. If W_r does not exceed 0.25 W_0, it is unnecessary to cross-balance. If W_r = 0.25 W_0, a counterbalance of equivalent weight $W_{c4} = W_1 - W_0$ can be placed directly opposite the pin at quarter (3) and the dynamic augment will not exceed that of the cross-balanced wheel by more than 3 per cent. This is practically negligible.

Section VII—Analysis of a given Counterbalance To Determine the Exact Over-balance and Dynamic Augment

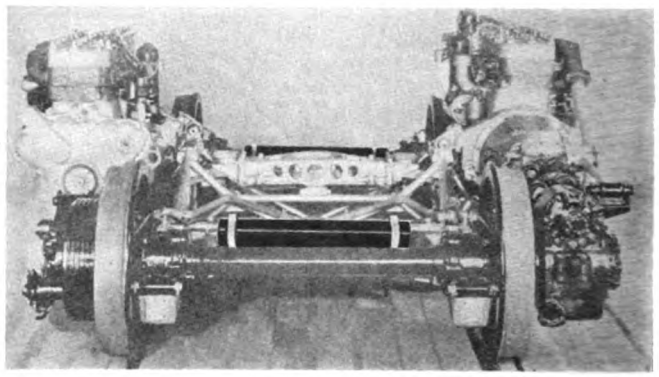
This section is illustrated by Fig. 1(d) and 1(e).

37. W_c = Equivalent weight of counterbalance in pounds.....3,170 b
38. b = Angle made by radius through center of gravity of counterbalance with diameter through quarters 3 and 1. Fig. 1 (d)..... 8 deg.
39. W_{c3} = Component of counterbalance acting at quarter (3) $W_{c3} = \cos b \times W_c$.....3,140 lb.
40. W_{c2} = Component of counterbalance acting at quarter (2) $W_{c2} = \sin b \times W_c$..... 441 lb.

Burgess Mufflers Used on Railplane

THE Railplane, built for and under the direction of the Pullman Car & Manufacturing Company by the Stout Engineering Laboratories, Dearborn, Mich., incorporated a modern adaptation of airplane principles to rail car design. The car is driven by two 160-hp. Waukesha motors.

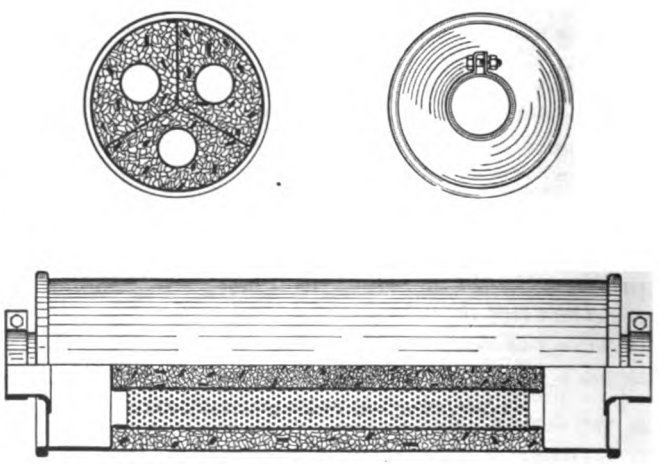
To muffle the exhaust noises of these large motors without decreasing the effective power output, mufflers



Burgess mufflers as applied to the Waukesha engine exhausts on the Railplane power truck

of the Burgess straight-through, full-power type were applied, as shown in one of the illustrations.

With no baffle plates, back-pressure is said to be reduced to the minimum in these mufflers. They are



Details of the Burgess gas-engine muffler design

made in accordance with the same principles employed by the Acoustic Division of the Burgess Battery Company, Madison, Wis., in mufflers which are standard equipment on many of the leading American and European automobiles.

Effective sound absorption is accomplished by a straight, perforated-tube lining backed up by a sound-absorbing packing. Keeping the back-pressure at a minimum tends to permit the motor to develop full-power, accelerate rapidly and operate at high speeds with minimum gasoline consumption.

The Effect of Sulphur On Aluminum Cars

Seventy-ton cars in the service of the Alcoa Ore Company for a period of two years show no indications of corrosion

THE transportation of sulphur, or of materials with a sulphur content, has always been a cause of grave concern to railroads, because of the fact that sulphur so readily attacks side and slope sheets of hopper cars.

Ten 70-ton hopper cars, with bodies of aluminum, were placed in service by the Alcoa Ore Company two years ago.[1] It was the first time that aluminum had been suggested for hopper car construction. Theoretically its use was sound, but actual service tests had not been made, and both railroad officers and car builders were awaiting the results of these tests with interest, to see whether aluminum would be strong enough to withstand the heavy loads it was expected to support.

The ten cars were used for transporting bauxite from the Alcoa Ore Company's mines in Arkansas to East St. Louis. About the same time the Missouri Pacific decided to test an aluminum hopper car in the sulphur service, in order to see how the new metal would withstand the attacks of sulphur.



Five of the 10 aluminum hopper cars which have been in service for two years

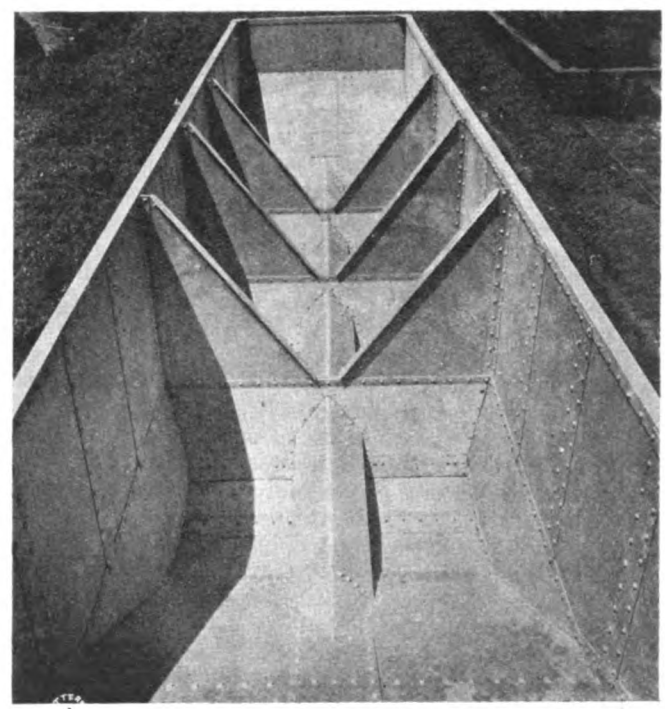
A car identical in type with the other ten was leased to the Gulf Coast Lines, and was used to take sulphur from deposits located at Bryan's Mound and Hoskin's Mound to Freeport, Texas.

A report on the car was made every month, which included the number of loads carried during that period, the nature of the repairs required, and details concerning the deterioration, if any, noticeable on the side and slope sheets of the car.

The only repair made consisted in replacing a hopper chain, not of aluminum, which broke early in service. Since then the car has made 116 trips fully loaded with sulphur and has travelled, thus loaded, a distance of 2,540 miles.

It was noted that the slope sheets, instead of corroding and forming a scale which would retard dumping operations, remained bright and shiny, and the contents could be dumped faster than if the car had been made of ordinary materials.

This discovery was quite remarkable, particularly since corrosion conditions are usually so severe. Cases are on record where hopper cars, loaded with coal (which contains sulphur up to 4 per cent), have stood in railroad yards near Lake Superior from autumn to spring. The corrosion resulting from sulphur attacks was so pronounced that the bottoms of the cars dropped out, along with the coal, after the latter had been stored in the hoppers for only a few months.



The interiors of the cars indicate the ability of aluminum to withstand corrosion

The theory that sulphur had no effect on aluminum was accordingly tested by placing the aluminum hopper car in service. It was also reasonable to assume that if

[1] These cars were described in detail in the *Railway Mechanical Engineer* for April, 1932, page 131.

aluminum could withstand the direct attacks of sulphur, then it should certainly be an ideal material for cars carrying such sulphur-bearing material as coal.

In order to test this assumption, scientists of Aluminum Research Laboratories, New Kensington, Pa., placed three aluminum hoppers outside the laboratories, filled them with coal, and left them there for two years.

The coal used in the experiment was bought especially for its high sulphur content. The hoppers were built of the same alloy used in the construction of the car for the sulphur trade. After two years, no noticeable depreciation in the aluminum could be found. The thickness of the aluminum sheet was the same as that of the steel ordinarily used.

Steel sheets for sulphur-carrying hopper cars, incidentally, are made to special thickness in order to combat corrosion as much as possible. The aluminum sheets used in hopper cars now under construction are 1/16 in. thinner because the additional thickness was not necessary.

While the tests on this new type of carrier were made by the Missouri Pacific, several other railroads placed test cars in operation. Results so far obtained support the service experience of the aluminum hopper cars on the Gulf Coast Lines.

The car has a length over striking castings of 41 ft. 11 in.; an inside length of 39 ft. 11 7/8 in.; an inside width of 9 ft. 6 in.; and a height of 10 ft. 6 in. from rail to top of body. As constructed by the Canton Car Company, Canton, Ohio, the car weighs 38,900 lb. Similar cars built for the Alcoa Ore Company to the same general dimensions, but utilizing heavier materials, weigh 60,000 lb., or 21,200 lb. more than the aluminized unit.

Budgeting Locomotive Department Expenditures*

By J. A. Anderson†

THE budgeting of locomotive department expenditures is a correlation of the maintenance and servicing of equipment with the financial allowance available for those purposes, to best meet the service and federal requirements.

Probably the best way to exemplify budgetary control is to outline its operation in the locomotive department of the Milwaukee. The present system of budgeting is the result of the failure or inadequacy of the former practice of allocating a given number of employes for each point, specifying classification and rates of pay. This system was not alone impractical, but expensive as well—particularly when a general officer, located at a great distance from the scene of activity, was endeavoring to regulate the maintenance and servicing forces without being fully acquainted with the details of changing service and maintenance demands.

The budgeting system in use at present operates along the following lines: Each master mechanic and shop superintendent receives a monthly allotment of money for each point where employes under his jurisdiction are located, the amount designated being based on payroll estimates submitted by these officers. The division officers have the authority to balance their forces to best suit the operation, that is, to regulate the number of journeymen and helpers of each craft to correspond with the amount of work contemplated for these craftsmen, and to adjust the common labor forces to meet the service requirements. The officer in charge is further permitted to control his allotment from a divisional standpoint in order that he may divert sufficient money from one point to another on the same division to take care of fluctuating demands caused by local conditions.

The Basis of the Budget

The budget control system similarly provides an allotment system for locomotive repairs separate from the amount alotted for the remainder of the labor expense. To this end, the proper levels of locomotive maintenance and servicing costs were determined after a thorough survey of accumulated records of maintenance costs and mileage made by individual locomotives. The maintenance statistics used included the costs of labor and material separately and collectively.

As locomotive mileage and the cost of maintenance and servicing were the only data that could be promptly and conveniently assembled, the cost per locomotive mile was the unit selected for comparative purposes on locomotive repairs. For enginehouse expense, the unit cost per locomotive handled at each terminal, and the cost per mile by divisions was used.

The ratios of material costs to labor costs were developed from analysis of material and labor costs, and by applying this ratio it is possible to foretell with a surprising degree of accuracy the aggregate costs of locomotive handling and maintenance for the ensuing month.

For the purpose of controlling and checking current expenses, statements of locomotive miles run and payroll totals, subdivided between locomotive maintenance and other expenditures, are prepared as of the 7th, 15th, 23rd, and last day of each month, the data from which these statements are compiled being available a few days after the close of each period.

After the close of each month, data are collected and statements are prepared showing by divisions and classes of locomotives the maintenance cost per locomotive mile, the cost of repairs to individual locomotives by the various shops, the cost per locomotive handled by locatoins, and the cost per mile for enginehouse expense by divisions. Each master mechanic and shop superintendent is furnished with copies of these reports, together with a copy of the statement showing charges for labor, material and other expense to individual locomotives.

In this connection, an organized and well balanced program for the performance of locomotive classified repairs, designed to restore run-out locomotive miles, has been followed. This arrangement includes a require-

*Abstract of a paper presented before the Western Railway Club on Monday evening, January 15, at the Hotel Sherman, Chicago.

†Master mechanic, C. M. St. P. & P., Milwaukee, Wis.

ment that the master mechanic furnish ninety days in advance of the proposed shopping date, a condition report for each locomotive that is coming due for classified repairs, this report indicating in detail the work which will be necessary to restore the locomotive to a condition which will guarantee another full cycle of mileage. While reduced earnings during the last few years has had a somewhat disorganizing effect on the operation of our shops, careful budgeting and strict control of expenditures have enabled us to maintain in desirable condition at greatly reduced costs, sufficient locomotive power to handle, without detention, the tonnage moved over our railroad during the past three years as well as the increase in business which it was our good fortune to handle during the past six months, and with a margin of good power still in storage to cope with demands should business increase beyond the peak reached during the summer months.

The labor allotments and cost statements developed in connection therewith have enabled the division officers, as well as the supervisors in each group, to realize that they must conserve to the fullest extent the expenditures for material and the charges to shop expense, as well as the monetary disbursement for direct labor, if their cost per mile is not to be excessive when compared with similar operations on other divisions. This has also promoted a close study by the officials and supervisors of each group of all items of expense entering into the respective operations.

Penalty Overtime Greatly Reduced

Penalty overtime, prior to budget control, was not curtailed to the extent that economical operation demanded. This was due in part to insufficient flexibility in local control of working forces and to some extent, perhaps, to lack of vigilance on the part of supervisors whose anxiety to expedite repairs to certain units of equipment by working employes overtime was substituted for better judgment and the more economical status of having the work performed during the regular bulletined hours.

It was convincing proof to all that in order to obtain the greatest possible production from an allotment strict curtailment of overtime hours at penalty rates was essential. The allotment basis, together with authority to regulate forces, while not effecting a complete cure to the extent of eliminating all overtime, was a remedy which prevented all except that overtime which was inevitable on Sundays and holidays and that occasioned by emergencies, in which the necessity for the immediate restoration to service of damaged or defective equipment would not permit deferring repairs until they could be made during the hours designated by bulletin, as the regular working week day, when straight time applies.

Although the total annual locomotive department payroll has been reduced almost 60 per cent during the last eight years, the percentage of penalty overtime to total payroll has been lowered each year.

The possibilities and opportunities for a more economical operation were further enhanced by the fact that under budget control the operation at each point constitutes a business all its own, and the supervisors in charge are granted authority to display their talent as business men as well as their ability to maintain and service locomotives. Their problems was transformed from one where the primary object was to perform a certain amount of work with a fixed mechanical and laboring force and with scant attention paid to costs, resulting in lack of proper return for the money expended, to one in which it is imperative that a certain amount of work must be accomplished for a fair allowance of money, based on equitable comparisons, to cover the task to be completed.

Investigation as to the extent to which budgetary control is used on other railroads discloses various systems, some roads adhering to the man allotment, while others have amplified the system here described and issue a maintenance of equipment allotment to the divisional mechanical heads who further subdivide the allowance into labor, material and fixed charges. I have worked under all three systems. The one in use on the Milwaukee Road is simple, meets the service requirements, and is a system whereby the expenses can be controlled, giving the division mechanical officer sufficient authority to properly balance his working force.

The Saving of Life and Limb*

Remarkable advancement has been made, but much still remains to be done

"YOUR railroad has made an excellent record in recent years in reducing the accidents to employees. Won't you tell me what, in your opinion, the officers and foremen of the mechanical department can do to reduce still further the number of such accidents?"

This question was addressed to the Superintendent of Safety—a man who has been engaged in this work for many years. We had followed his progress closely, not only because of the noteworthy results obtained, but also because he is distinguished for his clear thinking and his fearless efforts to improve conditions.

Discipline and Breaches of Rules

"In the first place," he replied, "and in order that you may have a proper background, let me say that our practices in general are not materially different from those of other railroads which are included in the upper 25 per cent, from the standpoint of safety performance. We attempt to thoroughly educate our employees in, and to inspire them to follow, the rules and practices which we have established in the interests of safety. We carefully check up each accident to place responsibility and take necessary corrective action. More than this, we insist that the supervisors report instances of non-observance of our rules, even if no accident occurs, and that such delinquencies be treated exactly as if an

* Eighth of a series of interviews with men outside the mechanical department, commenting in a constructive way upon the possibilities of that department.

accident had actually resulted from each breach of rules."

"You discipline them even if no accident occurs? Isn't that going to unusual lengths?" I asked.

"Some people seem to think so," replied the Safety Superintendent. "We know from experience, however, that such a handling produces real and substantial results. You cannot afford to compromise with safety principles. It is a serious offense to overlook an unsafe practice, whether the particular instance results in an accident or not. It is a potential source of danger and the next breach may result in a serious accident, or even a fatality. Unfortunately, this is constantly being brought home to us." (He showed me recent records of fatalities caused by violations of specific rules.)

Where Foremen Fall Down

"Getting down to a more direct answer to your question," continued the Superintendent of Safety, "I would say that our chief endeavor is to get the foremen to comprehend clearly and to assimilate the safety rules, to imbue them with a realization of their responsibility for the safety of those under their direction, and that no operation is an efficient operation unless it is also a safe operation. In this we have had a considerable measure of success as our records in recent years show. There is, however, much still to be accomplished."

"In my opinion," continued the Superintendent of Safety, "every man employed in a supervisory capacity should have a 'safety sense,' as it were, developed by a thorough study and understanding of the safety rules and a carefully cultivated keenness to discover and correct unsafe methods and practices. We spend a lot of time and money to correct defects in a locomotive, a car, or a machine tool, in order to guard against possible failures in service. Why should we not be as careful and critical in examining and training each employee to insure against possible accidents?"

"What evidence have you that some foremen are indifferent?" I queried.

"For one thing," replied the Superintendent of Safety, "certain groups are always consistently below their fellows in safety performance. For another, our checks show clearly that some foremen are not observant of breaches of rules. They seem to have no sense of unsafe practices, even when they are quite pronounced. One cannot escape the conclusion that these foremen are either too lazy or too indifferent to voluntarily exert a reasonable amount of energy to study and concentrate on this problem."

"Is this not sufficient cause for their demotion or elimination from service?" I ventured.

"I believe it ultimately will be," promptly answered the Superintendent of Safety. "It surely will be, in my opinion, as we succeed still further in raising our standards and approach more nearly to our ideals—and we surely have made rapid progress in the railroad field in recent years in demonstrating that safety is an integral part of efficient operation, in addition to increasing the respect and appreciation for the value of life and limb."

Getting a Line on the Individual

"After all," I remarked, "is not the problem in its last analysis that of reaching each individual in the organization and of securing his wholehearted co-operation?"

"Absolutely," came back the answer. "And this means that a careful study must be made of the performance of each individual in the organization. Incidentally this will prove invaluable in other directions. For instance, focusing the attention of the foremen upon such a study and analysis of the individual will be extremely helpful in finding ways and means of making that individual a more efficient employee in other respects and in encouraging a greater loyalty on his part to the railroad."

"Will it mean the elimination of employees who insist upon following questionable practices?" I asked.

"Quite probably," replied the Superintendent of Safety. "But, frankly, I do not believe there will be many such separations from the service. As a matter of fact, it is so much to the employees' interest to follow safe practices that I believe we can expect a maximum of co-operation if we can convince them of this fact, and surely the officers and foremen should be able to do that if they themselves are fully sold on the proposition. As a matter of actual experience the great majority of employees go along with safety cheerfully after a certain period of training."

"The railroads generally have made splendid progress in safety performance in recent years," I said. "Can we expect to greatly improve upon the present performance?"

"Certainly," replied the Superintendent of Safety. "A careful analysis indicates that many of our accidents are entirely inexcusable and are due to 'human failures.' Education; closer and more intelligent supervision; fair, impartial, but invariable discipline for proved violations —and a wholesome fear of it—will still further reduce the number of accidents in railway service."

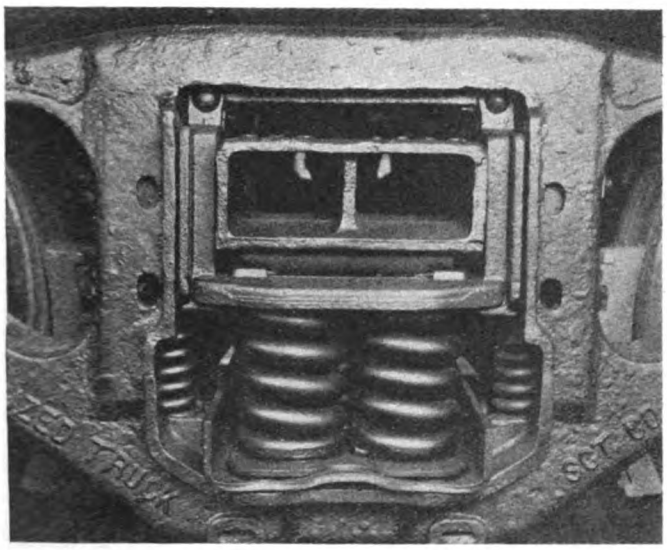
Barber Stabilized Truck

AFTER two and a half years of extensive research, laboratory experiments and road tests, the Standard Car Truck Company, Chicago, announces the development of a new freight-car truck design which, in addition to other important features, is said to prevent excessive vertical oscillation of car bodies at critical speeds, thus minimizing damage claims, reducing car maintenance costs and providing increased safety at modern high operating speeds. The truck, known as the Barber stabilized truck, is designed for use (either with or without the Barber lateral-motion device) on cars of all capacities. It comprises essentially conventional construction, except for the provision of friction elements under spring tension in the side-frame columns to dampen the vertical movement of the spring-supported bolster. This dampening effect, which is proportional to the car load, tends to assure easy riding at all speeds and, in effect, provides increased spring capacity when most needed.

The new Barber stabilized truck has been tested under the drop hammer at the American Railway Association draft-gear laboratory, Purdue university, and in the A. R. A. road service tests recently conducted at Rochester, N. Y. Additional road tests have been made with the stabilized truck under Santa Fe and Swift Refrigerator Lines' cars, two of these test installations having been in service for a period of over 13 months. Advantages said to have been demonstrated in tests of the new truck design include: (1) Effective dampening of vertical oscillation due to harmonic spring action; (2) increased spring carrying capacity from 12 to 15 per cent without the use of additional springs; (3) elimination of all wear between the bolsters and columns because these members do not contact; (4) provision for vertical friction members which are self-cleaning and en-

closed in columns where they are, to some extent, protected; (5) reduction of car roll to a minimum because of the dampening of spring action; (6) tendency to eliminate broken truck springs, due to the reduction of excessive vertical oscillation; (7) practical elimination of lost motion or looseness in the truck, since the small amount of wear anticipated on the friction blocks is automatically taken up as it develops.

The stabilized truck utilizes side frames furnished by any of the side frame manufacturers, who may be licensed to arrange for the slight change necessary in the column design. Standard A. R. A. bolsters are used, except that



Close-up view showing details of Barber stabilized truck, including the application of the Barber lateral-motion device

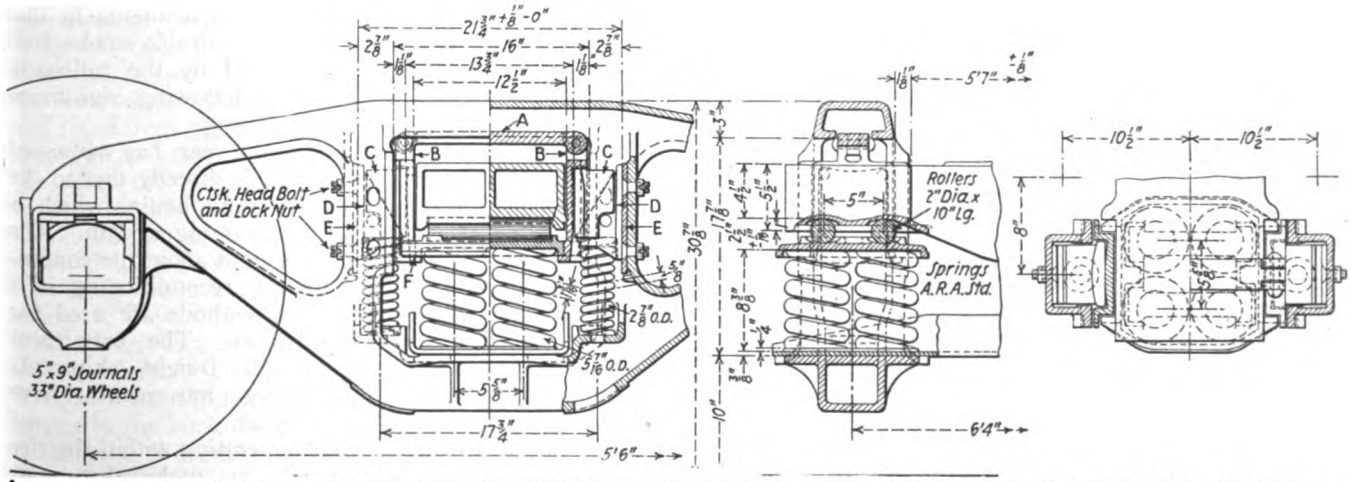
with the Barber lateral motion application a slight change in the bolster is required. The coil springs also are of standard A. R. A. design, the four large outer coils being located as usual under the bolster ends and two small inner coils being transferred from their usual location to the side-frame columns where they provide necessary tension on the tapered friction elements.

Referring to the drawing, the construction of the Barber stabilized truck for a 40-ton car, including the application of the lateral-motion device, is illustrated. A yoke, consisting of a cast-steel top compression bar *A* and two cast-steel side members *BB*, is located around the bolster. The lower edges of the side members are flanged to engage the underside of the lateral-motion roller plate *F*. Wedge members *CC* are also of cast steel and make contact on a plane of 60 deg. with the chrome-nickel friction blocks *DD* producing a frictional resistance against the hardened wear plates *EE* which are secured to the columns of the side frames by suitable countersunk bolts and lock nuts. It is the friction produced at this point which breaks up the destructive harmonic action of the truck springs, permitting just enough movement to give an exceptionally easy riding car, whether empty or under full load. Another important factor in the design is that the outer faces of the vertical members of the yoke are provided with a convex surface, or rocker face, to compensate for irregularities in the manufacture of the side frame. This assures full and uniform bearing of the friction block against the wear plate.

The use of the Barber lateral-motion device is recommended, but, should this feature not be desired, the Standard Car Truck Company has provided for a design which does not incorporate this feature. In that case, the yoke is eliminated and the standard A. R. A. truck bolster inserted. The cast-steel wedge blocks are provided with lugs on the lower edges to engage the truck bolster, instead of the roller plate as in the initial design.

The standard A. R. A. Class C springs, with 40-ton capacity per car, have a solid capacity rating of 57,000 lb., of which the two inner coils produce 7,000 lb., or 12.28 per cent of the group. The Barber wedges, which are of cast steel, are designed with a 60-deg. angle; therefore, the horizontal component pressing against each side of the yoke or bolster is about 6,060 lb. at solid capacity. The friction blocks have a chrome-nickel content with a bearing surface chilled and ground and a contact area of 76 sq. in. per side frame. This produces 160 lb. of pressure per sq. in. at full or solid capacity; but, under normal full loads, this pressure will not exceed 50 per cent, or 80 lb. per sq. in. This low unit pressure tends to promote long service life.

Under drop test in the Purdue laboratory using the 27,000-lb. tup, the free oscillations of this Class C spring group, 15 in number, were reduced to three with the Barber stabilized device. The Purdue tests also indicated that by reason of the frictional "build up," the foot-pounds of energy absorbed in producing a full spring closure of $1\frac{11}{16}$ in. were increased from 4,050 to 4,610, an increase of 13.8 per cent in actual capacity of the spring group. This was in addition to absorbing the harmonic timing or bouncing and tends to prevent the springs going solid. The limited action of the springs also is expected to prevent the repeated development of excessive stress which is a prolific cause of fatigue failures and spring breakage.



Arrangement of spring-supported friction elements in Barber stabilized lateral-motion truck as designed for a 40-ton car

EDITORIALS

Safeguarding Employees From Accidents

In an interview on The Saving of Life and Limb, reported on another page, a superintendent of safety makes some excellent suggestions as to how the mechanical department can improve its record in that respect. Seventy-five per cent of the total so-called industrial accidents on the railroads are said to be in the maintenance-of-way and equipment departments. In 1932 the total casualties in the maintenance-of-way department were 4,965 and in the maintenance-of-equipment and stores departments 4,733. The average casualty rate for the 29 occupations listed in the maintenance-of-equipment and stores department was 6.59, and 13 of these occupations had rates above this average. Eliminating four of these occupations which have comparatively few employees, we find the following results:

Occupation	Number of Casualties	Casualty Rate
Carmen, class B	56	11.36
Carmen, class A	288	10.44
Regular apprentices	110	9.38
Boilermakers	222	8.72
Laborers in shops, enginehouses and power plants	642	8.55
Helper apprentices	41	8.52
Machinists	780	8.49
Blacksmiths	73	7.06
Common laborers in shops, enginehouses and power plants	523	6.49

These facts give some indication, at least, of places where efforts can be focused to effect the largest reductions, although the casualties, even in those occupations with the best records, are still too large, and no reasonable effort should be neglected to reduce them still further.

Incidentally, the railroads can take some pride in the results that have been obtained in the past ten years by concentrating attention upon accident prevention. Important factors in this campaign have been the annual awards of the Harriman Memorial medals and certificates under the direction of the American Museum of Safety, and the Railroad Employees' National Safety Contest, under the direction of the National Safety Council. In commenting on the Railroad Employees' National Safety Contest last year, the president of the National Safety Council said: "An analysis of the progress made during the nine years of the contest reveals the fact that on a cumulative basis there have been 3,003 less employees reported killed on duty, and 451,018 less employees reported injured, than would have been killed and injured had there not been the year-by-year reduction in rate killed and rate injured, as compared with the respective fatality and injury rates recorded in the year 1923."

It will not be an easy task to continue the rate of reduction that has been achieved in recent years, but it is vitally important, in the interests of humanity and as a cold-blooded business proposition, that continuous and decided progress be made in still further reducing these casualties. Results which were at first made possible by emotional and high pressure campaigns have gradually been succeeded by those based on painstaking study and effort in searching out the causes of accidents and in setting up the machinery to reduce and eliminate them. This painstaking effort must be continued and stimulated in order to create a universal habit or "safety sense" among the employees on American railroads. The mechanical department, because of the large number of casualties among its employees, must shoulder a considerable part of this responsibility.

Engine Terminal Smoke Abatement

Early in 1933, the new Union passenger terminal at Cincinnati, Ohio, was placed in service, being designed to serve all seven of the railroads entering the city, and comprising, among other carefully co-ordinated facilities, a modern power plant and engine terminal. A point particularly stressed in the design of the latter units was the provision of modern equipment to minimize smoke and enable the terminal to meet the rather rigid requirements of the local smoke ordinance. Steam for all heating purposes, as well as for generating compressed air for the terminal, is furnished by three efficient high-pressure boilers of 1,000-hp. capacity each, located in the main power plant. These boilers also supply steam which is used directly in locomotives for building up steam pressure after the boilers have been washed out and refilled, and without the necessity of starting fires while the locomotives are in the enginehouse, or, in fact, until just before they are assigned for service. All 20 of the stalls in the enginehouse and 10 of the outside radial tracks are equipped with high-pressure steaming and blow-off mains for blowing down, washing, refilling and steaming locomotive boilers by this method, and the remaining seven outside radial track stations are equipped for maintaining a working steam pressure on the locomotives without fires.

The effectiveness of this method of engine-terminal operation in reducing objectionable locomotive smoke was rather strikingly emphasized in the 1933 annual report of the Smoke Abatement League of Cincinnati, as prepared by Secretary Frank H. Lamping. This report comments on the increased difficulty of smoke-abatement efforts in 1933, owing to economic conditions which have tended to increase the use of cheap, high-volatile coal for heating homes and apartments in that territory, thus contributing to an undesirable smoke condition. Regarding smoke developed by the railroads, however, the report contains the following significant statement:

"The railroad situation, during the year, has witnessed a remarkable improvement. This is directly due to the completion of the new terminal roundhouse, which is now operating under the direct-steaming system. The completion of this project has brought about the concentration of locomotives undergoing reconditioning in a terminal where the best possible methods are used for the purpose of smoke elimination. The betterment can be recognized even though freight shipments demanding increased locomotive movements have materially increased during the year.

"The officials of the railroads operating within the city limits are co-operating diligently in smoke abatement. They are continually improving equipment and firing

methods in order to bring it about. During the year, the Cincinnati Superintendents' Committee, through their smoke department, took the following disciplinary action, not so much for punitive measures, but to keep the work constantly before the employees of the railroads."

Total railroad observations	19,182
Number of violations	261
Percentage of total	1.4
Reprimanded	113
Demerits	42
Suspended five days	29
Suspended ten days	43
Cautioned—Previous good record	18
Contributory causes	11
Dismissed	5
Out of service	10
First offense	1

Another large industrial center in which the railroads are co-operating with the local smoke-abatement offices is the Chicago district, where an extensive, systematic study is being made of all industrial and railway fuel-burning equipment and firing methods, using a special force of 150 trained engineers and observers. This study, conducted under the general direction of Frank A. Chambers, deputy inspector, Department of Smoke Inspection and Abatement, Chicago, is being financed by the federal government as part of its increased employment program and must be completed in three months.

While most of the information from this study will be devoted to industrial fuel-burning equipment, an important part of the study will cover railway fuel-burning practices at terminals and yards throughout the district, and it is already apparent that, with the co-operation of responsible railway officers, a substantial improvement in smoke conditions can be obtained in conjunction with an equally desirable increase in the efficiency of fuel use.

New Loading Rules Book Wins Approval

The approved loading rules of the American Railway Association, Mechanical Division, have been developed over a period of many years, and represent a tremendous volume of work in the aggregate in testing and specifying methods of loading various commodities with the required degree of safety and at a reasonable cost. As pointed out by C. J. Nelson, superintendent of the Chicago Car Interchange Bureau, at the February meeting of the Chicago Car Foremen's Association, the classes of shipments gradually increased in number resulting in a substantial increase in the size of the book of rules and, moreover, necessitating numerous cross-references to avoid repetitions which would have made the rule book still larger and more unwieldy.

To meet the demand for a rule book of more convenient size and ready reference, the arduous task of revision was undertaken in the latter part of 1931 and completed in the new book prepared by the Committee on Loading Rules and issued for general use, effective January 1, 1934. In spite of adding some new details, the committee was successful in reducing the size of the book considerably and eliminating practically all cross-reference, except references back to the general rules. Changes in the book arrangement have been made without changing the intent of any of the former rules and the few changes in rule details have been formally approved by letter ballot.

Detailed changes in the arrangement of the book of loading rules were discussed at length at the car foremen's meeting mentioned, and, judging by the favorable comment in that discussion, the new book will meet the approval and needs of car inspectors and supervisors generally.

Air-Conditioning Here— What About Insulation?

Rather complete information furnished in tabular form in the February *Railway Mechanical Engineer* indicated that a total of 648 air-conditioned passenger cars were in service in the United States up to December 31, 1933. Since the first of this year, the desirability of this modern improvement in passenger equipment has received such general acceptance and support by carriers throughout the country that many additional orders have been placed or are contemplated, arrangements having been made to finance some of these installations by government loans. All types of equipment are contemplated, including electro-mechanical, direct-mechanical, ice and steam-ejector systems, and installations will be made not only in lounge cars and diners, but in sleepers and day coaches as well. A recent study indicates that, in addition to the 648 air-conditioned cars in service in 1933, the railroads of this country have already ordered, or are considering the purchase of, over 2,200 air-conditioning equipments to be installed in passenger cars of all classes during 1934.

The significance of this development can hardly be over-estimated. It means that a bold attempt is to be made to attract and hold passenger traffic from competing agencies and, while the economic justification for such large expenditures for a facility which may be classed as a luxury, is subject to some question, there can be no doubt of the public demand for air-conditioning, nor of the fact that the equipment of railway rolling stock with this modern facility will give employment to many railway men, as well as to employees of equipment and supply manufacturers.

One factor which deserves particular attention in any study of air-conditioned equipment is the question of car insulation, since, unquestionably, present insulation is inadequate, in many instances, to meet the requirements of an efficient system for maintaining desired car temperatures at minimum cost. The possibilities of the various types of insulating media should be studied with the greatest care to assure the use of those adapted to the special requirements of particular installations. In the case of new cars, the added ½ in. or more of insulation thickness, considered necessary for use with air conditioning, could probably be provided at little extra labor cost and not over $75 increased cost per car for material. With existing equipment, the tearing out of interior finish and applying additional insulation to car sides, ceiling, air ducts, etc., may amount to $2,000, more or less, per car, largely for labor. In considering this cost, however, the important thing to remember is that the additional insulation contributes to passenger comfort and reduced cost of operation, summer and winter, throughout the life of the car. In other words, it is a paying investment.

A suggestion which will interest railway men at least was advanced recently by a keen student of modern trends who waxed highly enthusiastic about the pos-

sibilities of general air-conditioning and said that manufacturers of air-cooling apparatus adapted for use not only in rolling stock but also in industrial plants, office buildings, hotels, homes, apartments, etc., could well afford to make railway installations free of charge, in view of the favorable publicity and attendant demand for general air-conditioning. Certainly there is some merit to the contention that business men and other travelers who have just left a comfortable train in intolerably hot weather will be rather insistent that office buildings, hotels and apartments to which they go shall be equally well provided with modern facilities which are designed to maintain comfortable indoor atmospheric conditions irrespective of outside weather.

Whether or not this idea is adopted, there can be no question that air-conditioning as applied to railway equipment is being rapidly extended and presents a problem of equipment design, maintenance and operation with which railway officers must thoroughly familiarize themselves.

The Passenger Train Of the Future

The new light-weight, high-speed articulated train units, one of which, of aluminum construction, has already been delivered to the Union Pacific and another of which, of stainless steel construction, will soon be delivered to the Chicago, Burlington & Quincy, have captured the popular mind. They have restored something of the romance which the railroad formerly possessed for the layman, but which more recently has been lost to the newer forms of transportation. The public is thus visualizing a general rebuilding of passenger service and passenger equipment departing completely from time-honored externals and capable of traveling at high rates of speed.

The popular appeal of these radically changed types of equipment is of inestimable psychological value to the railways. Entirely aside from the ultimate soundness of every feature of the new types of equipment, full advantage may well be taken of the opportunity they afford to re-establish in the public mind a feeling that the industry is by no means suffering from hardening of the arteries and is still capable of a certain restrained youthful enthusiasm.

But these types of equipment confront practical railroad men with problems which must be faced coolly and thought through carefully before sound policies can be adopted with respect to the long-time treatment of the passenger-equipment inventory. The major objective of the railways with respect to passenger service and equipment is, first, to stop further attrition of the volume of passenger traffic and get back as much as possible of the traffic already lost; second, to reduce the cost of performing passenger service sufficiently to permit the attainment of the first objective at a profit.

The new materials and types of construction attack the problem of operating costs by the reduction of weight in passenger trains which railway men today generally admit has become excessive. Reduced weight, combined with reduced cross-sectional area and attention to the principles of aerodynamics in shaping the exterior, has permitted the possibility of speeds sufficiently high to serve as an increased rail-travel incentive without developing excessive power demands. In order to effect every possible reduction in weight and to facilitate easy riding at high speeds the articulated type of construction has been adopted. The train thus becomes a relatively inflexible self-propelled unit, well adapted to a particular class of service. This is a complete departure from the customary conception of the coaches as the units and a flexible train consist of universally interchangeable equipment.

If the new train types are as effective in attracting patronage as the popular interest already shown in them would indicate, the railways will ultimately face the necessity of some adjustment between these two conflicting conceptions of passenger rolling-stock design. These adjustments may be made on at least three different bases: (1) The gradual replacement of existing passenger rolling stock with new more or less inflexible train units which depart completely from present standards for interchangeability; (2) the gradual development of new types of cars in coach units, the characteristics of which would be low truck-center, coupler and floor heights and reduced body cross-sectional area: (3) an intensive re-study of design conforming to present dimensional standards, using new materials to reduce weight but designing to withstand the forces encountered in trains in which the new equipment is mixed with the old.

It is not yet clear whether articulated train units will replace existing types of equipment, except for certain specific types of service for which they can be tailor-made. Reduced dimensions are of value in two directions. They decrease weight and wind resistance. These benefits might be attained by the gradual adoption of coach units which depart from present dimensional and design standards. But this involves a new problem of standardization before such equipment can be utilized except in service localized to the owning road. The capital investment in the present passenger rolling-stock inventory, on the other hand, is a factor strongly favoring the perpetuation of present standards as to form and dimensions. Undoubtedly much can be done in replacements along this line to reduce weight and passenger-train operating costs in the future. The ultimate economy, however, may be somewhat less than can be attained by a departure from present standards and the ultimate development of new ones.

One of the outstanding changes which the new types of construction have effected is in the ideas as to power-capacity requirements. Both types of three-unit articulated trains are, or will be, equipped with power plants of 600 hp. nominal capacity and both are expected to develop maximum speeds in excess of 100 m.p.h. Whether this power-plant capacity will prove to be sufficient is a question which can only be answered by experience, as no exact basis of predicting the quantitative effect of streamlining on full size models moving over the ground has yet been established. Whether or not experience justifies the judgment of the designers of these two trains, a power plant designed for a specific train unit can scarcely handle an increase in the number of coaches at schedules based upon a full utilization of power-plant capacity with normal consist. Aside from the matter of the size of the crew, the self-propelled train unit can scarcely be superior to a train propelled by a separate locomotive unit whether the unit be a steam or a Diesel locomotive.

The new types of equipment, whether or not they are perpetuated in their present form, are doing the railway industry an inestimable service in pointing the way toward reduced costs and improved service to the public. In what direction will these possibilities be realized?

THE READER'S PAGE

Tapping Taper Stud Holes

To the Editor:

Taper stud holes in boiler steel plate are ¼ in. per foot taper. This I believe is the most generally accepted practice. I find it not always possible to obtain as good a thread as with straight holes where the whole tap passes through the hole and is not backed out. Many of the taper holes are found to have one or more sections of the thread torn. We have tried various forms of taps, both ground and cut on a lathe, and various numbers of flutes from three to six, some milled so that not more than 3/16 in. of the thread is left. We have also used as a lubricant everything from white lead to several of the highly praised compounds. Still we cannot always depend upon every hole being as good as required. On some sheets this is not so noticeable, while on others purchased from the same specifications the trouble is greatly increased.

Perhaps some of your readers would like to contribute their views on this subject.

Shop Superintendent.

Methods of Counterbalancing Locomotives Questioned

To the Editor:

The extension of the application of cross-counterbalancing locomotives has led to an examination of the present practice, which reveals some interesting facts.

In the first place, the designer, although he thinks he is calculating a dynamic balance, uses the static weight of the back end of the main rod as revolving weight. Of course, this rod should be treated as a mass having a motion of translation combined with rotation about the crosshead pin, and its effect should be computed by treating its weight as concentrated at its center of gyration. The error is in the neighborhood of 140 lb. for a large locomotive.

Next, he probably treats the total weight of the eccentric crank as concentrated at the crank pin and neglects the weight of the eccentric rod. The error due to the former is around 80 lb., and the error due to neglect of treating the light end of the eccentric crank and the effect of the eccentric rod as weights at 90 deg. to the crank pin may be as high as 30 lb. in the 180 deg. weight and 100 lb. in the 90 deg. weight. Then he makes the right-hand and left-hand wheels alike. If computed correctly, there should be a difference that may amount to about 25 lb. in the resultant balance weight and a difference of 5 deg. or more in the angle of its offset.

Because he took too large a weight for the back end of the main rod, he uses too small a reciprocating weight at the front end. Then there is the question of how much of this weight to balance. More about that later.

When the wheels are completed, the balance is to be checked. He finds in his book of rules long formulas involving cos θ and, perhaps, cos 2 θ, which will require a page or more of computation. Then, on the balancing ways the center of the axle has to be established, an arc scribed of a radius to be computed by a formula requiring the diameter of the crank pin to be measured; and, by means of a plumb line, the crank is brought to position at the angle θ from the vertical. Actually all that is necessary to make as accurate a check as possible of the mounted wheels is to subtract from the 180 deg. weight computed for the wheel to be weighted, in the early stages of the design, the amount of the 90 deg. weight of the opposite wheel, and bring the crank to the horizontal position as determined by the quartering gage.

If both wheels are mounted when the balance is checked, it is necessary to make certain assumptions regarding the correctness of the weight on the opposite wheel, whether cross-balancing or simple balancing is sought. We will assume that the wheel is to be checked by itself. The angle of the balance has been calculated to the minute, with no arithmetical mistake, and the wheel has been made perfectly to the drawing; yet the chances are that it will not check, for most wheels are made with different weights of spokes or plate and rim on the two sides of the balance, making the effective angle less than the computed one.

But why cross-balance, anyway? If there results any reduction in dynamic augment, the decrease is accomplished by reducing the percentage of reciprocating weight balanced. Cross-balancing does not lessen the longitudinal disturbing forces. When the percentage is dropped from 50 to 31.5, the force setting up fore-and-aft oscillations is increased by 37 per cent, if the added weight is placed opposite the crank pin. But it will probably be placed on the center line of the offset weight computed for the revolving weights. In that case the longitudinal force will be increased more than 37 per cent. This would be serious in some service.

The reduction in percentage lessens the dynamic augment, of course, but if simple balancing was followed, and the weight added for the reciprocating masses was so applied that the dynamic augment would be the same on all wheels, the augment with the 50 per cent weight would often be about what it would be for 31.5 per cent and cross-balancing, while the longitudinal force would not be increased. Cross-balancing decreases the forces tending to cause nosing, but that seems to be a minor consideration with long, heavy modern locomotives.

The wheels are completed and placed under the engine. It is expected that the riding of the engine will be the practical test of his work, but good riding is only one of the objects sought in counterbalancing. Riding, too, is affected by the condition of the track, the freedom of the boxes, the springs, the maximum angularity of the main rod, the total steam pressure on the piston, the steam distribution, the weight and travel of the valve, the valve gear, the amount and location of the spring-supported weight of the engine, the kind and condition of the tender buffer, the weight of the tender and its load, the weight of the train and particularly of the head-end cars, the draft gears of the tender and the head-end cars, the speed, and even the time interval since the riders had dinner.

Surely this subject should be better understood.

G. E.

With the Car Foremen and Inspectors

Train Inspection— In Yard and en Route*

By A. A. Lauer†

ON the Southern Pacific we work on the principle that the best way to avoid trouble is to remove the fundamental causes and do so by stressing the need for thorough conditioning of triple valves, tight brake pipes, painstaking leakage tests by enginemen, testing of retainer valves at designated points, correct piston travel, close attention to draft rigging and air hose, careful education of enginemen in the handling of air brakes and constant attention to those numerous other details of maintenance and operation which have a vital bearing upon avoidance of stuck brakes, break-in-twos, slid flat wheels and damage to brake rigging.

Our principal yards are located about 500 miles apart. Cars arriving and departing in those yards are placed in thorough condition and, as a rule, require very little attention at intermediate points. As a train arrives in yards where car inspectors are employed they station themselves where they can give entire train a careful rolling inspection. Rush cars are usually blocked at the head or rear and are given first attention by inspectors for prompt release to yardmen. When inspection is completed and bad order cars tagged, the cars are then turned over to the yardmen for switching. In some yards it is found advisable to have traveling carmen make the rounds of the industrial, team and house tracks to effect minor repairs so as to avoid having to take to the rip track numerous cars requiring light repairs or delay outbound train while making the repairs. When trains are made up, the usual inspection is made in accordance with I. C. C. regulations and general practice. Trainmen are required to look train over to see that hand brakes are released and assist carmen in making rolling inspection as train departs. We have no hump yards with depressed inspection pits as the volume of traffic through any one yard is not sufficient to justify the investment. Standing inspection of freight trains is made every 50 to 80 miles in open country and, as a rule, coincides with water stops. Stops are made at intervals of 7 to 10 miles on heavy descending grades to permit wheel heat to equalize. Inspection is made at such points by trainmen. On these heavy grades where view is obscured we require a trainman to ride on rear of the caboose to watch the track for indications of derailed wheels, and by night we light the track to the rear of these trains with two inspectors' lanterns. We make a standing air brake test before descending heavy grades and give the train a rolling inspection at every opportunity when stops are made. In snow shed territory we make use of electric reflector type lights, permanently located on foundations at the wheel level and facing the track to aid trainmen in making rolling inspection. These lights are actuated by track circuits as trains approach and depart. Trainmen are required to ride on top of trains to change retainers as required and to watch for overheated wheels, excessive fire flying or other indication of trouble. In certain districts where operating conditions are especially difficult, such as through snow shed territory, we make use of emergency air hose cut in between cars and extended to top of train so that trainmen may apply air if an emergency arises and his stop signal can not be seen. We have discontinued requiring that a proceed signal be passed from rear to head end passing stations or open telegraph offices as we found it impracticable. We require agents, operators and trackmen to watch trains in passing and to signal trainmen when occasion requires.

Generally speaking, we use carmen to inspect trains about every 250 miles. Whenever possible, trains hold the main track at intermediate division points located every 100 to 125 miles and, as a rule, there are no car inspectors at those points. Trainmen of inbound crew make standing inspection and outbound crew makes rolling inspection as train arrives and again as it departs. Passenger trains are also inspected by carmen about every 250 miles. Lids of journal boxes are not lifted unless there is indication of heating. Oil is added about every 500 miles. Passenger trainmen are required to patrol train at regular intervals while in motion and to watch train around curves and through deep cuts to the best advantage to detect evidence of hot boxes or other trouble.

With the foregoing presentation of what is done to condition equipment, operate and inspect it, the question as to what results are obtained naturally arises.

Our records show we are remarkably free of accidents which may be traced to the quality of our train inspection but that on the contrary, both carmen and trainmen, including the enginemen, render a good account of themselves in detecting trouble at its inception and taking necessary action to prevent serious results. I think you will agree with me regarding this when I tell you that during the first seven months of this year we made 315 million freight car miles and 60 million passenger car miles, or a total of 375 million car miles, with record as follows of train accidents in any way traceable to failure of carmen or trainmen properly to inspect equipment or to place cars in safe condition to complete trip after defects were discovered:

2 cases of journals burned off.
1 case of steam shovel not properly loaded and shifted en route.
3 cases of brake beams down.
1 case of bottom rod dropping.
1 case of arch bar failed at old defect.
5 cases of wheels broken account overheating.
1 case of car derailed entering siding account vertical flange.

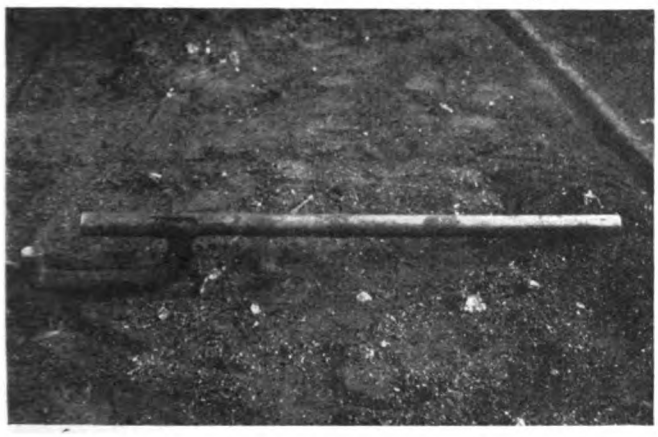
A total of 14 cases in seven months, or an average of 26,785,000 car miles run per reportable defect which employes failed to detect or properly care for. With an average of only two such failures per month in operating over some 9,000 miles of trackage we feel reasonably satisfied with our procedure but recognize the fact that eternal vigilance is the price of safety.

* Abstract of a paper presented at the annual meeting of the Safety Section of the National Safety Council.
† Supervisor of transportation, Southern Pacific.

An Improved Dolly Bar

THE dolly bar shown in the illustration was designed for bucking center-plate, body-bolster, diaphragm and center-sill cover-plate rivets. The bar is held horizontally and the extension from the handle acts as a lever for holding the rivet in place. The carman merely raises up or bears down on the bar and because of its weight the rivet is firmly held.

The bar is made of 1¾-in. specially treated tool steel and is 38 in. long. Because of the weight it eliminates much of the shock received when using lighter type bars and once its use is adopted the riveting gangs prefer it to other types of dolly bars.

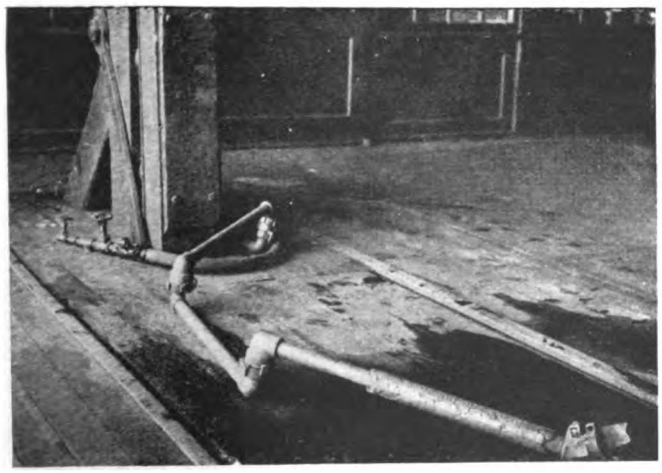


A dolly bar for center-plate and cover-plate rivets

Protector for Yard Steam-Heat Connector

WITH the elimination of steam hose for yard-line connections in coach yards and passenger stations, steam lines equipped with metallic connectors were installed. Many car inspectors have been painfully burned while attempting to connect or disconnect the yard lines to passenger trains on account of the pipe connection becoming hot from the steam.

This condition can be eliminated by applying a piece of steam hose or other heat-resisting tubing on the end of the connector, just behind the coupling as shown in the accompanying illustration.



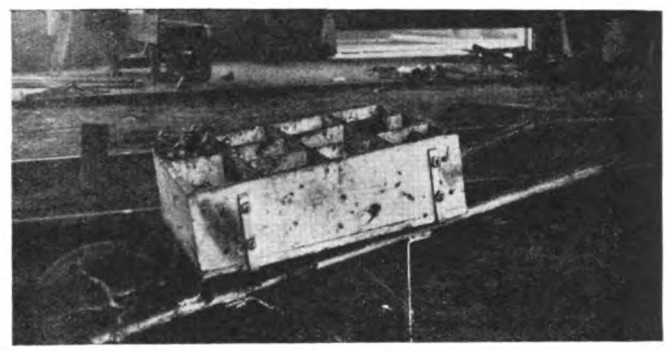
Safety protection on a yard steam-heat connection

Portable Tool and Rivet Containers for the Car Shop

FOR the car foreman who objects to seeing dolly bars, rivet sets and other tools lying around the ground in the steel car shop and finds it inconvenient to have six or eight different containers setting around each rivet forge in the shop, the two portable containers herein illustrated will be found of particular interest. One is a wheelbarrow container for dollies and the other a portable rivet container which is divided into a number of compartments.

Each rivet container is divided into eleven compartments, the size of which is governed by the size and quantity of rivets used. If a riveting gang were assigned to drive underframes on box cars, the container would be filled with only 1-in., ⅞-in. and ¾-in. rivets. But if one were assigned to a job where the majority of his work required the use of ⅝-in. rivets, he would naturally supply himself with rivets of that size. The container eliminates the unsightly appearance of many special containers and reduces to a large degree the number of rivets left lying around on the ground.

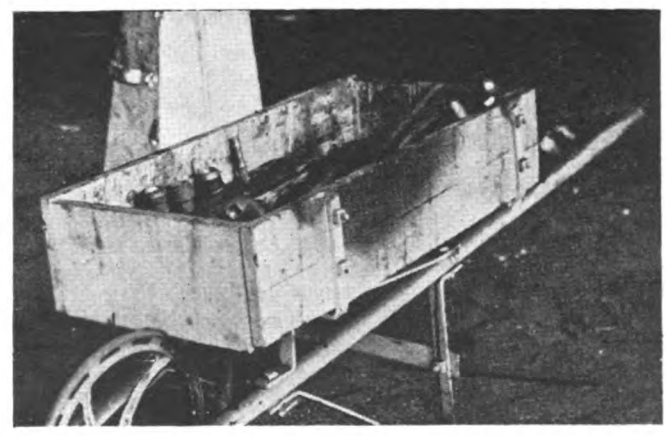
A block attached to one side of the box of the tool wheelbarrow provides a place to insert the various sizes



A portable rivet container for the riveting gang

of rivet sets and drifting pins and the balance of the box has a flat bottom which permits the dolly bars to lie flat, making it possible to select the type of bar needed without disarranging the entire outfit.

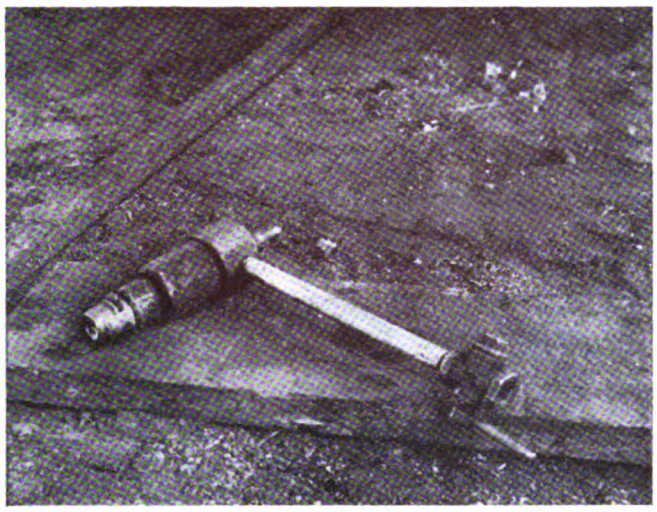
The frame of each wheelbarrow is made from 1¼-in. pipe, at one end of which is attached a 12-in. wheel. The body of the tool container is made of 1-in. pine, 36 in. long, 18 in. wide and 7 in. deep. The body of the rivet container is made of the same material, 24 in. long by 18 in. wide and 9 in. deep.



A tool wheelbarrow for the riveting gang

Pneumatic Rivet Buckers

THE construction of many of the freight cars today have indicated much sill damage is being experienced because of the fact that sill and underframe rivets are not being driven tightly which permits the sills to shift and the rivets to shear off when the cars are handled in 100- to 150-car trains. The average carman pays little or no attention to whether a rivet is driven sufficiently tight to withstand a hammer test for tightness and while an inspection of the rivet head would indicate to the casual observer that it was tight the chances are that many of them are really quite loose. This condition results in many failures due to the sills buckling under extreme pressure or to breaking of diagonal braces or end sills.



Pneumatic rivet bucker for use between center and draft sills

Many loose rivets occur because the bucker fails to secure a good leverage on the rivet head before the rivet is driven. To overcome this cause one car foreman provided his riveting gangs with the pneumatic bucker which is shown in the accompanying illustration. It is used between the center or draft sills and will hold all rivets in place tightly while they are being driven. It is made from a 6-in. cylinder with a 5-in, piston to which is inserted the proper size rivet set. A pipe of sufficient length to permit its operation between the sills is provided and an ordinary cut-out cock is attached. A ⅜-in. hole is drilled through one side of it to permit release.

Handling Explosives*

By E. J. League†

THE Bureau of Explosives has been in operation since 1907. In that year there were 101 deaths, 62 injured, and a property damage or loss of $496,280 just on explosives alone. Those figures did not include the other dangerous articles such as gasoline, acids, poisonous articles or inflammable solids. To go back that far tonight is too much to tackle so let us take the last 15 years and see what the picture looks like.

Fig. 1 includes both the explosives and all the dangerous articles and shows the number of persons killed in 1918 to be nineteen, gradually coming down to 1932, last year, when there were no fatalities whatever. Compare this 15 year record with that of 1907 with 101 deaths.

The middle section of the chart shows the number of persons injured during the past fifteen years, running from 106 in 1918 down to but 19 in 1932. Comparing that with the 62 injuries in 1907 is quite a drop and one that we all can be proud of.

The top section of the chart shows the property loss which starts off in 1918 with $1,600,000. That amount drops gradually until 1932, the total property loss is $373,000. Comparing that amount with $496,820 in 1907, it doesn't at first glance, look so well, but the 1932 figures include all the explosives and the other dangerous articles as well, while the figures for 1907 were for just the explosives. The loss for 1932 on just explosives was only $27, so we can still point to the record with a great deal of pride.

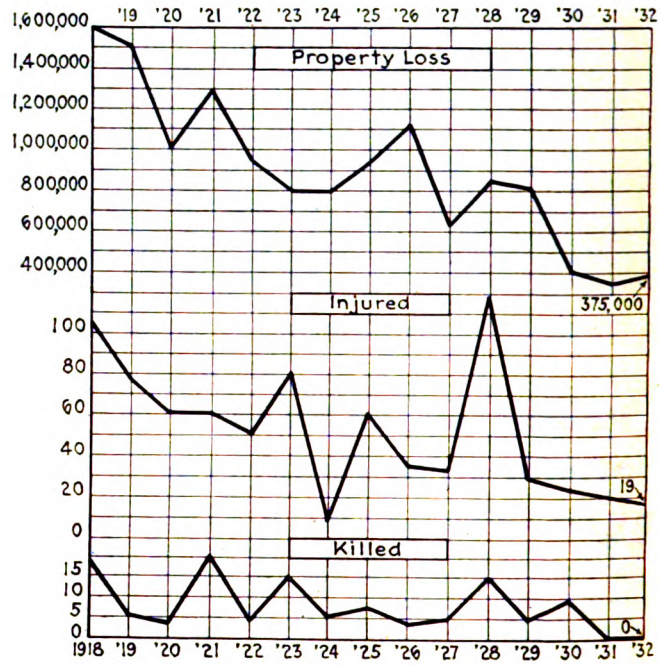


Fig. 1—Loss in railway handling of explosives and all other dangerous articles

While we are talking figures, let us dig into just a few more and then we will be through with figures. Take, let us say, a 10-year period—the last 10 years—and average the total property loss for one year. Then let us tear that yearly average apart and see just what particular class of this dangerous freight gives us the most trouble and why.

This next chart (Fig. 2) is not a "baloney dollar" but a mightly effort on my part to draw you a picture of a 33-in. car wheel. Usually such illustrations are represented merely by a circle but, in compliment to your association, I chose the car wheel. As shown in the center, the wheel represents a total of $713,000, the average yearly property loss for each of the past 10 years. Splitting that amount up into the several different classes of Dangerous Articles we find the following:

* Part of an address presented at the Chicago meeting of the Car Foremen's Association of Chicago.
† Inspector, Bureau of Explosives, Chicago.

1.5 per cent, chargeable to explosives; 2.7 per cent, acids and corrosive liquids; 83.33 per cent, inflammable liquids; 9.7 per cent, inflammable solids; 1.1 per cent, compressed gases; .03 per cent, poisonous articles; 1.4 per cent, semi-dangerous commodities.

From this chart one can readily see that inflammable liquids are responsible for 83-1/3 per cent of our total property loss and, I dare say, 90 per cent or more of that volume was in tank cars. We must not, for a single minute, let up in our efforts to properly handle all classes of this dangerous freight for a single accident to a car of explosives or to a car of chlorine gas could easily cause enough property damage to equal this total of $713,000 in itself. So without letting up on those smaller percentages, we must give more, much more attention to the inflammable liquids, most of which, of course, move in tank cars. It is not my purpose to tell you how to do that. There are rules in your department and in the I. C. C. regulations, most of you know them as well as I do. I just want to impress you with where the most of our trouble lies.

Now let us take this same total of $713,000 and break it up another way, this time showing the percentages due to the different causes. This next chart (Fig. 3) is another 33-in. car wheel which in its entirety represents the average yearly loss each year for the past ten years. Starting at the top we see that 3 per cent was chargeable to negligence of employes. Isn't it a source of satisfaction to see that proportion the smallest of them all? Following around the wheel we find the other proportions are: 4 per cent, rough handling; 4 per cent, loading methods and containers; 81 per cent, wrecks and derailments; 2 per cent, spontaneous heating or excessive sensitivity; 6 per cent, miscellaneous and unknown causes.

Let us group the negligence of employes, rough handling, and loading and containers, a total of 11 per cent.

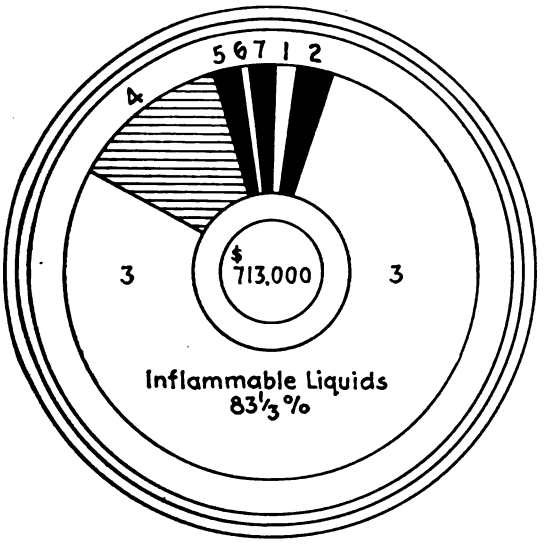


Fig. 2—Proportionate average yearly property loss due to various causes

All of us are familiar with the great efforts put forth by the carriers to educate employes by bringing them together in meetings similar to this where they can exchange experiences and they themselves suggest different and improved ways of doing things. We listen to speakers who have specialized in some particular branch of railroad work such as the Freight Claim Division of the A.R.A. or the Container Bureau. We have air-brake and other instruction cars. The Bureau of Explosives has been, and still is, constantly working on improved containers for these dangerous articles and policing their use.

Our chemical laboratory is perhaps the only one of its kind in the world and the results of their tests are acknowledged the country over as authority. Their many tests on spontaneous heating have brought about a large number of changes in the manufacture of many com-

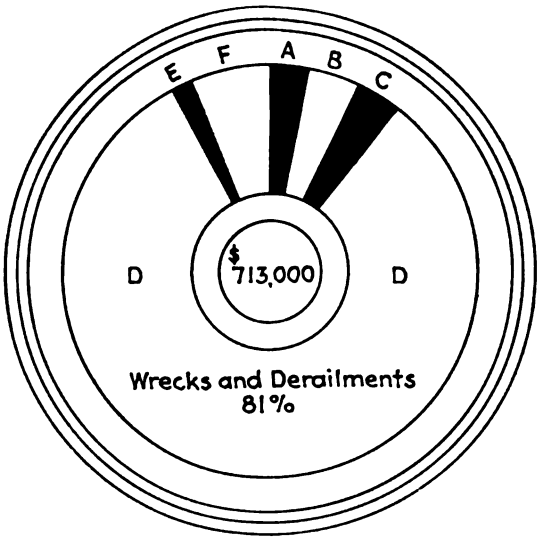


Fig. 3—Proportionate causes of the average yearly property loss of $713,000

modities, different methods of packing and some of them prohibited entirely from transportation by rail.

Let me give you some illustrations of our investigation work in cases of spontaneous heating. If I were to tell you that we have had fires in sandpaper, peanut skins and burnt popcorn, you might believe me but you would perhaps be inclined to think it was deep stuff and let it go at that. Let me try to explain it so that you will see that it is as simple as a, b, c.

In one of our Chicago yards we had a fire in a carload of sandpaper, the cause of the fire not being apparent so anybody's guess was good. The first thing usually given in cases like that is "sparks from an outside source." That seemed reasonable for whoever heard of sandpaper starting a fire unless you struck a match across it?

The rolls of sandpaper were examined and it appeared that the fire started inside the rolls and burned outward. A five-pound sample was sent to our laboratory and they found that after the paper had been coated with sand, it had been treated to a mixture of chinawood oil and linseed oil. Apparently, the oil mixture had not been given sufficient time to dry. When tightly packed, as in a roll, it began to heat. A simple explanation or comparison would be rags soaked with linseed oil and wadded up in a ball. We all know the likelihood of fire from such rags and, you remember, rags go into the manufacture of paper. As a result of our tests, the manufacturer of the sandpaper changed his methods and, so far as I know, there have been no more fires.

Another interesting case, that of peanut skins sometimes called peanut bran. Large candy companies remove the thin skin from the kernel before putting it into their candy bars. These skins are sold to fertilizer factories who put them under great pressure and squeeze out the oil. The residue is used as a fertilizer. The skins are usually packed by the candy people in jute bags or gunny sacks of about three bushels each. The material is so bulky for its weight that to get the minimum

into a car, it must be jammed up tight to the roof. This large bulk and tight packing do a miniature job of squeezing out the peanut oil and the oil together with the gunny-sack material tend to favor spontaneous heating and, if conditions are just right, we can have a fire. Of course, the shipper says "sparks from an outside source."

Just another illustration, that of some four or five fires in waste cracker-jack. Stale cracker-jack, floor sweepings and partly popped grains of pop-corn were bagged up in gunny-sacks and shipped to nearby farmers for hog-feed. Samples were examined and our laboratory found that the partly popped grains were scorched and liable to spontaneous heating when loaded in tightly loaded box cars. The remedy was to store this material before loading for about a week so it could cool off by exposure to the air and thus greatly reduce the fire hazard.

[At this point, Mr. League discussed the large proportion of loss and damage due to wrecks and derailments, which he said may be charged in general to three causes, man failures, equipment failures and track failures. He emphasized the educational work and the many research activities now under way in an effort to minimize these failures.—EDITOR.]

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Car Damaged-Owner Responsible; Failure to Control Moving Cars

The Shell Petroleum Corporation delivered a loaded tank car in O. K. mechanical condition to the Indiana Harbor Belt. The car, while standing at the head of a cut in the railroad's classification hump yard at West Gibson, Ind., was struck by another rapidly moving tank car which was also loaded, although listed as an empty car. While the damage to the moving car was comparatively slight, the standing Shell Petroleum Corporation's car, although not derailed, was badly damaged. Center sills were bent down, spread and split open from the bolster to the end; draft lugs, buffer, carrying iron, coupler, draft gear, yoke, cross-key and other parts were broken or missing. The car was returned (loaded) to the owner with request for a defect card through Chicago Interchange Bureau inspector, which was declined, but a joint inspection certificate was executed. A defect card was, however, subsequently issued for missing coupler, draft gear, yoke and cross-key under Rule 95. The Shell Petroleum Corporation contended that the railroad was responsible for all damage to the car under 1931 interchange Rule 32, section d, paragraph 5, because the I. H. B. erred in listing the moving tank car as empty when it was actually loaded and consequently failed to control its speed properly by the car retarding device. In support of the contention of improper handling in switching, evidence was submitted showing that the cross-sectional area of the center-sill construction was 43.98 sq in., whereas the A. R. A. requirement is only 30 sq. in. The railroad contended that the damage was confined to the A end of the car between the body bolster and the end of the car, and that section 5 of Rule 44 specifically provides that such damage shall be considered owner's responsibility provided car was not subject to unfair handling as outlined in sections a, b, c, e, f, m and o of Rule 32. Inasmuch as the car in question was not subject to any of these conditions, they contended that Rule 44 was not applicable and owner was responsible.

In a decision rendered April 7, 1933, the Arbitration Committee ruled that: "Paragraph 5, Section (d), Rule 32, 1931 Code, reading 'Failure to properly control moving cars with car-retarding device,' applies only where damage to one of the first three cars in moving cut, or one of the first three cars in standing cut, results in a combination of defects as outlined in Rule 44. This is an arbitrary measure adopted to define unfair impact in switching, without regard to whether or not a car may meet the A. R. A. strength requirements. It also serves as the means of determining whether or not car was improperly controlled by the retarding device. Therefore, since the damage to car in question did not form a combination of defects as outlined in Rule 44, and as no evidence is presented to show that the car had been derailed or unfairly handled under any of the other conditions of Rule 32, the car owner's contention is not sustained."—*Case No. 1723, Indiana Harbor Belt vs. Shell Petroleum Corporation.*

Billing Repair Card Altered After Rendition of Bill

The St. Louis-Southwestern applied two new cast-iron wheels to a Pacific Fruit Express car at Pine Bluff, Ark., and submitted a billing repair card showing that the wheels were mounted on an 80,000-lb. axle with wheel seats 6⅝ in. The same road also applied a set of wheels to another P. F. E. car at Shreveport, La., and submitted a billing repair card showing that the wheels were mounted on an 80,000-lb. axle with wheel seat 6⅞ in. Both wheel changes were made on account of car owner's defects and charges were for new wheels, less scrap credit. The Pacific Fruit Express, after checking, returned the billing repair cards and wheel statements to the railway, requesting that charges for new wheels mounted on axles with over-size wheel seats be reduced to second-hand value in accordance with Rule 98, interpretation 5. The St. Louis-Southwestern declined to make an adjustment and returned the papers after changing them to show 6½-in. wheel seats on the first car and 6 7/16-in. wheel seats on the second car, these dimensions being standard for the wheels applied. These alterations in dimensions were made after checking to agree with the railroad's wheel-shop records. The railroad explained that the changes were made to correct errors and to make the bills conform to their carefully kept shop records, as provided for in the Wheel and Axle Manual. The Pacific Fruit Express, on the other hand, contended that it was against the principles of interchange rules to make alterations in billing papers after they had been checked by the car owners.

In a decision rendered April 7, 1933, the Arbitration Committee ruled that: "As repairing road failed to avail itself of the opportunity of checking dimensions of axle with wheel-shop records prior to rendition of bill, the dimensions shown on billing repair card should govern. Charges should, therefore, be reduced in accordance with Rule 98, interpretation 5."—*Case No. 1722, Pacific Fruit Express Company vs. St. Louis-Southwestern.*

In the Back Shop and Enginehouse

Making Tank Hose Connection Gaskets

By A. Skinner

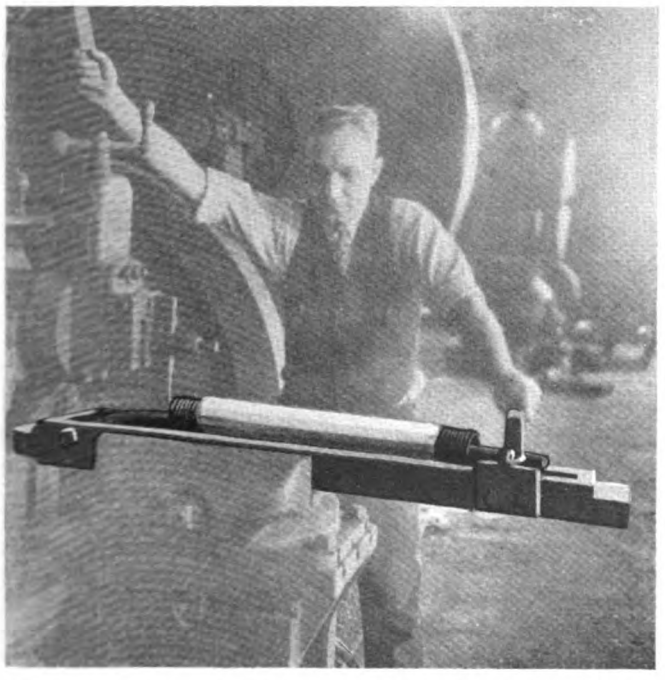
DISCARDED steam-heat hose unsuitable for further service can be utilized by cutting them into gaskets for tank-hose connections at relatively little cost by the use of the shop-made devices shown in the illustrations. These gaskets are required in 11 different sizes on one large railway system, as shown in the table, and can be made at the rate of about 500 gaskets per eight-hour day, dependent upon the size, using the equipment illustrated.

Table of Standard Gasket Sizes and Corresponding Cutting Tool Dimensions*

Gasket size	A	B	C	D	E
3⅝ by 2½	⅜	9/16	2 7/16	9/16	4⅛
4¼ by 3⅛	⅜	⅝	3⅛	⅝	5
4⅛ by 2 13/16	7/16	11/16	2¾	11/16	5
4¾ by 3⅝	3/16	9/16	3 5/16	9/16	5⅛
4¾ by 3½	¼	⅝	3½	⅝	5 1/16
4⅛ by 3	½	9/16	3	9/16	5⅛
3¼ by 2 13/16	7/16	9/16	2 3/16	9/16	4⅛
3¼ by 2½	⅜	⅝	2½	⅝	4½
3⅝ by 2⅝	¼	½	2⅝	½	4 3/16
3¼ by 2⅛	5/16	9/16	2⅛	9/16	3 15/16
3¼ by 2 5/16	15/16	¼	2 13/16	¼	5 3/16

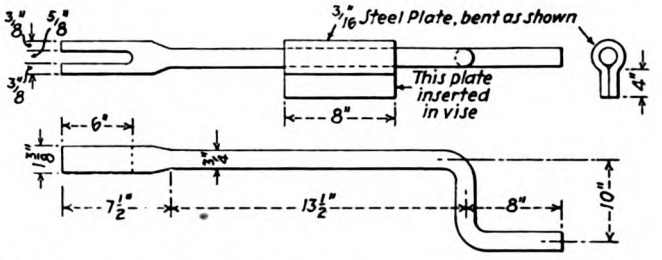
*All dimensions shown in inches.

The first operation, after removing the hose clamps and fittings, consists of splitting each hose lengthwise, using a special jig and parting tool in an ordinary shaper. The parting tool is ground to a sharp edge and the jig, held in the standard shaper vise, consists of a base plate, 45 in. long by 4¾ in. wide by 2¾ in. high, slotted along the center line to receive a ¾-in. round holding rod which is pivoted on a bolt at the shaper end of the jig and held down by a small hand lever at the other end.



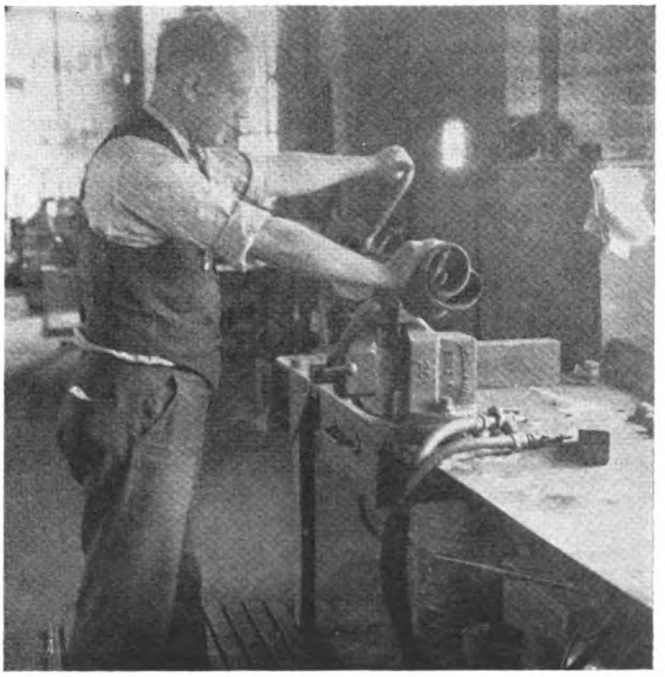
Special holding jig as used in a shaper during the hose-splitting operation

The hose to be split is simply inserted over this holding rod which is then swung down parallel with the base plate, compressing the hose slightly into the groove and holding it securely during the splitting operation. The stroke of the shaper is adjusted to the required length and the hose is split in one operation of the machine.



Details of the vise-supported crank used in rolling hose

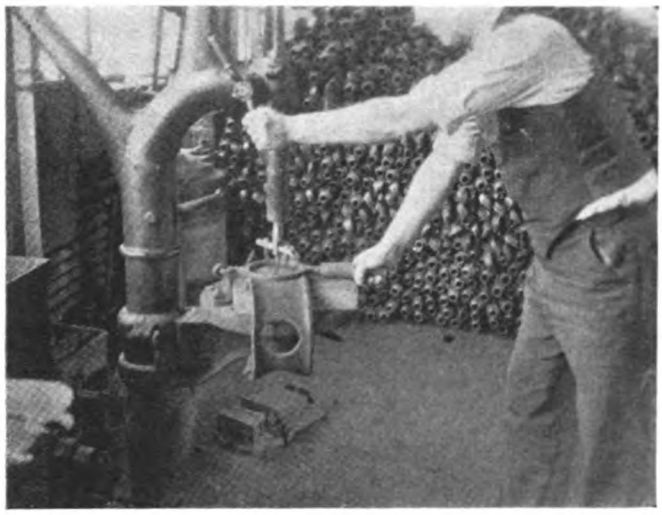
After the hose is split, it is rolled on the device shown in the second and third illustrations. This consists simply of a crank made of ¾-in. stock with a handle on one end and a slot on the other to receive the hose, the center bearing for the crank consisting of a 3/16-in. steel plate, bent, as shown in the illustration, and firmly supported in the jaws of a bench vise. One end of the



Crank device used in rolling and wiring hose preparatory to soaking them in a vat of boiling water

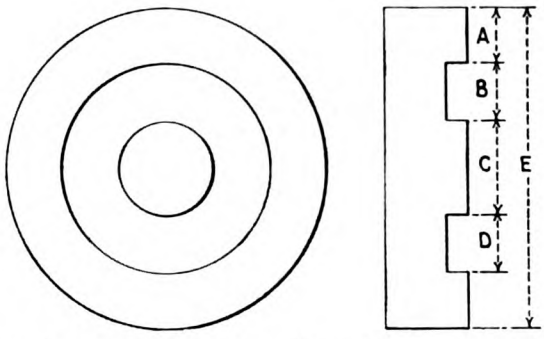
hose is simply entered in the slot, the operation of the crank winding up the hose, which is then wired and slipped off without difficulty. The object of this operation, including the wiring of the hose, is simply to hold it in a coil while immersed in a tank of boiling water, which tends to facilitate holding the hose flat while cutting the gaskets. Immersion of the hose in a tank of hot water for a few hours is usually adequate to accomplish this result.

In cutting the gaskets, a drill press is employed, utilizing a wood block arrangement and clamping device



Method of cutting tank hose gaskets using a special drill-press jig and adjustable cutter

which holds the hose flat while the gaskets are being cut with a special tool. This hinged holding device consists simply of a small bracket and eye bolted to the drill table and a hinged steel ring with 4½-in. inside diameter to accommodate the largest gasket. A rubber handle on the outer end facilitates holding the hose in a flat position while cutting the gasket. An adjustable three-bladed cutter, shown in the illustration, is used for the actual cutting operation, this cutter consisting of a horizontal bar firmly held in the drilling machine spindle and provided with one center cutter and two outside



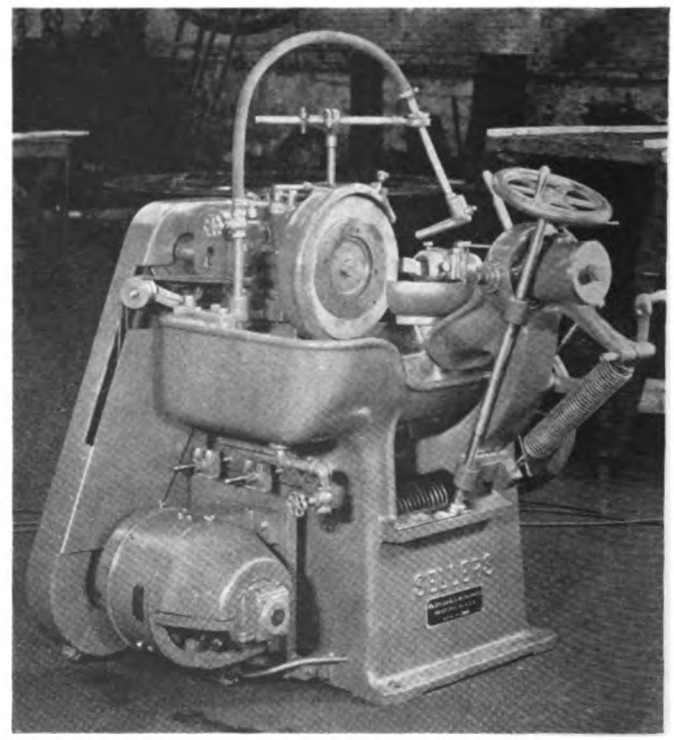
Design of gage used in setting the cutters accurately so as to produce standard gasket sizes, as shown in the table

cutters with screw adjustment along the bar. To save time and assure accuracy in the gaskets cut, 11 gages, of simple design and made to the sizes illustrated, are used in setting the cutter blades. All of the devices described in this operation are shop-made, with the exception of the adjustable cutter, which is of special design and apparently requires special steel cutting tools for the best results.

Improved Grinder for High-Speed Tools

THE new No. 2A tool grinder made by Wm. Sellers & Company, Inc., Philadelphia, Pa., is a completely redesigned and modernized machine, built to meet the exacting requirements for grinding cemented-carbide as well as high-speed steel tools. A most important change has been made in the spindle construction. Elimination of vibration or looseness of the spindle is essential in grinding cemented-carbide tools because this material is so brittle that it will chip unless the wheel is free from vibration or lost motion. For this reason a special pre-loaded ball-bearing mounting has been substituted for the plain bronze bushing in the earlier model.

The method of driving the spindle has been modernized, a V-type belt with the pulley mounted close to the bearings now being used instead of the former flat belt with greatly over-hung pulley. The axial oscillation of the spindle has also been improved. On the old machine this was obtained by an unprotected cam which caused



Ball-bearing spindle mounting and quickly changed wheel have been adopted on Sellers No. 2A grinder to meet conditions imposed by modern cemented-carbide and high-speed tools

the spindle to move back and forth in its own bearings. Now the spindle, with its pre-loaded type ball bearings, is mounted in a large bronze sleeve which is oscillated axially by a protected cam revolving at a fixed speed and arranged with a heavy coiled spring to keep the sleeve and cam in positive contact.

The whole grinding head has been designed for lubrication by a high-pressure grease gun system. This method, besides providing better lubrication, also keeps abrasive dust from working into the bearings. Back lash has been eliminated from the feed screw which acuates the in-and-out movement of the chuck. This has been accomplished by a heavy spring which insures positive contact between the nut and the screw. The wheel guard has been modified so that now it can be

readily removed after merely loosening one knurled nut. This is particularly advantageous where both cemented-carbide and high-speed steel tools are being ground on the same machine, because grinding wheels can be interchanged rapidly. The motor is no longer carried on a base plate but is mounted on the side of the machine and is arranged with a convenient adjustment for the main drive belt tension.

The holder is designed to take tool shanks up to 1½ in. by 2 in. The drive is furnished by a 3-hp. a. c. or d. c. constant-speed motor. The net weight is 2,770 lb. and the floor space occupied is 4 ft. 8 in. by 4 ft. 6 in.

Furnace For the Pipe Shop

IN order to make a satisfactory bend in steam and airpipes applied to locomotives in the back shop the pipe must be properly heated where the bend is to be made. Usually it is necessary to heat the pipe several times to effect a good job and where this is done on other than a special forge the job is somewhat difficult.

It is assumed that in the majority of the roundhouses and backshops natural or artificial gas is available and



Portable pipe-bending furnace

if connected properly can be used more efficiently and is less costly than fuel oil or coke forges for performing this operation.

The forge shown in the illustration is made from a hollow cast-iron block with numerous 1/16-in. holes drilled inside. The operating valve, mixing the gas and air, is located a short distance from the forge to eliminate any hazard to the mechanic lighting it off. After a good heat is established it only requires a few minutes to heat the pipe sufficiently to make a satisfactory bend in it.

Unique Type of Turntable Drive

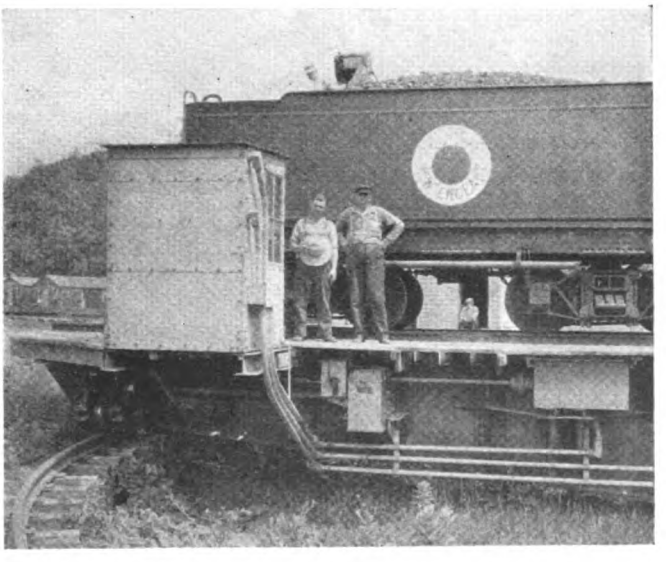
WHEN the Lehigh & New England lengthened its locomotive turntable at Martin's Creek, Pa., a little over a year ago, the table was converted from a center support to a three-point support, extensions being made at each end of the table. The location of the trucks remained unchanged, making it possible to leave the circular track undisturbed. The original length of the table was 80 ft. and equipped with four wheels at each end.

The drive for this table was furnished by the Whiting Corporation, Harvey, Ill. It consists of two separate units, one for each end of the table, the arrangement being the same as the bridge drive used on the Whiting Tiger crane, with the exception that spiral gears and pinions are used at each truck gear reduction, because of the truck-wheel axles being radial to the table's center bearing and the drive shaft parallel with the table girders.

Two 20-hp. motors provide the power and give the turntable a speed of 100 ft. per min. Duplex control is used, located in the steel cage placed at one end of the table. The cage also includes the foot-brake and other operating equipment. The power is applied to only one truck wheel at each end of the table. These wheels, equipped with M. C. B. type truck brakes, are lowered slightly from their former position, in order to provide the necessary traction. The remaining wheels of the trucks required no changes.

The illustration shows the cantilever extensions added to the ends of the table. The housing containing the motor is shown just below the front tender truck. The two housings below the front wheel of the rear tender truck protect the reduction gears and the foot-brake. The drive shafts are clearly shown. A similar unit is located on the opposite side near its other end.

With this arrangement, it was found possible readily to install a powerful unit without disturbing the end construction of the girders, and so locate the mechanism that it was readily accessible for inspection and repairs. There being no limiting dimensions for unit size, no expensive special additions were necessary to reduce friction as a compensation frequently necessary when driving mechanism mounted directly on trucks must be made purposely small for lack of space.

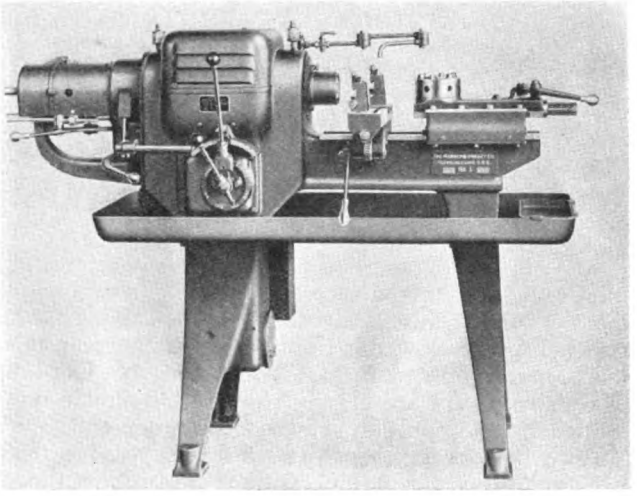


Whiting electric-drive unit for a modern three-point support turntable—Installed on the Lehigh & New England

High-Speed Electric Turret Lathe

A HIGH-speed turret lathe, with its motor built into the head of the machine, and new bar feed, has recently been brought out by the Warner & Swasey Company, Cleveland. The new lathe is designed for higher cutting speeds, which are becoming increasingly desirable, especially when carbide or diamond cutting tools are employed, and is particularly adapted to small diameter work and non-ferrous materials, where high speeds necessitate very high spindle revolution.

The machine is said to incorporate for the first time a completely self-contained alternating current motor drive; the rotor is mounted directly on the spindle, while the stator is in the head housing. Four speeds are available in either direction; 600, 1,200, 1,800 and 3,600 r. p. m. All gearing and belts are eliminated, resulting in



No. 1 electric turret lathe with motor built into head

a simple construction that provides ample power, free from trouble and excessive frictional losses. Perfect balance is easily obtained because there is but one rotating unit.

Overheating is guarded against by fan blades, rigidly attached to the rotor, which circulate a high-velocity air draft through cored passages around spindle bearings and motor windings.

Two levers, responding instantly to finger tip pressure, control the spindle electrically through a drum type controller and automatic relays. The shorter lever selects the four spindle speeds; the longer lever stops, starts and reverses, the spindle being quickly reversed without damage to the motor. A large band brake, actuated by the longer lever in the neutral position, prevents rotation when attaching chucks, loading work, etc.

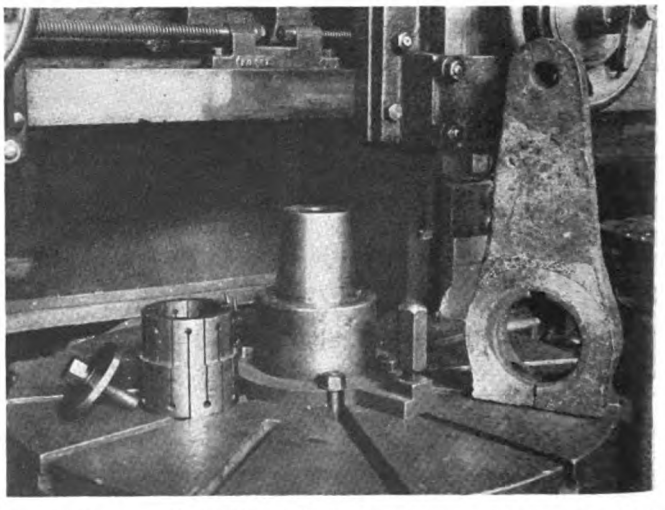
High speeds made possible by the new lathe have necessitated a new combination of bar feed elements. For this purpose a friction finger-bar feed has been developed, holding bars in a concentric position in the spindle to prevent vibration, and enclosing them for their full length in a protecting tube for safety. The friction feed finger lies immediately behind the collet so that bar stock can be used up to the last end. The finger is mounted on a feed tube, which, at the rear of the spindle, is reciprocated by a fork. No cams are used. Simple hand lever action and toggle linkage feed the stock, close the collet, and return the feed finger. The length of feed is controlled by a quickly set collar. Balance at high speed is secured by supporting bar stock in the spindle by a removable filler tube, which prevents excessive runout and vibration. Safety is assured by using a full length stationary supporting tube which reaches nearly up to the feed tube.

Eccentric-Crank Holding Fixture

AN eccentric-crank holding fixture, used at the Silvis (Ill.) shops of the Chicago, Rock Island & Pacific, for facing off the lateral wear surface of the crank square with the crank-pin hole, is shown in the illustration. Eccentric cranks, excessively worn in service by contact with the main-rod bushings, are reconditioned by undercutting the worn surfaces, building up with bronze and re-machining on a boring mill. In order to assure freedom from subsequent heating and as long service life as practicable, it is important to refinish this lateral bearing surface square with the bore of the crank-pin hole, an operation which is greatly facilitated by the use of the device illustrated.

This eccentric-crank holding fixture comprises essentially a substantial base plate and cylindrical block, 9 in. in diameter by 12 in. high, firmly bolted to and accurately centered on the boring-mill table. The upper end of this block is tapered, being 4¼-in. in diameter at the upper end and 6 in. in diameter at the lower end, the length of the tapered part being 6 in. An expanding sleeve with a corresponding internal taper and provided with two step sizes for the accommodation of crank arms with different sized crank-pin holes is illustrated, also the circular top plate and hex-head holding screw. The elongated hex-head nut, shown just at the right of the tapered center post, is simply an adjustable outboard support for the eccentric crank when mounted on the jig in a horizontal position.

In operation, the expanding bushing is placed over the tapered center pin, the eccentric crank applied over the bushing at the appropriate step size, and the top plate and holding screw tightened until the eccentric crank is accurately centered and firmly held in the correct position at right angles to the axis of the boring-mill table. A horizontal cut made with a cutting tool across the eccentric-crank face will then be square with the crank-pin hole.

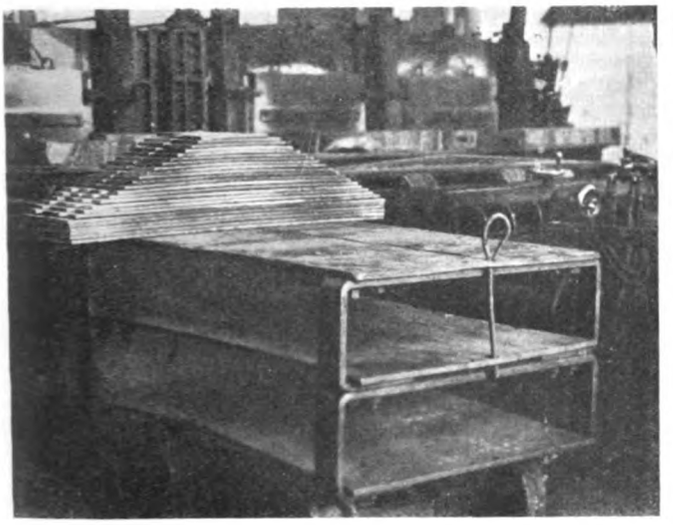


Eccentric crank holding fixture for use in facing the lateral-wear surface square with the crank-pin hole

Trailer for the Spring Shop

THE trailer shown in the photograph is used for handling spring leaves from the heat-treating furnace to the banding machine in sets ready for the banding operation. After the leaves are sheared, punched, formed and properly heat treated they are made up in sets. When the trailer is completely loaded it is moved to the banding machine and sufficient complete sets are available to keep the banding-machine operator busy for some time.

A narrow-gage track is laid between the furnaces and the banding machine at which point a switch is provided to permit the empty trailer being returned on an adjacent track for reloading. The trailer is made from 7/16-in. boiler plate mounted on a 1-in. by 4-in. wrought-iron frame. Roller bearings are used in the hubs of the cast-iron flanged wheels to permit easy movement of the trailer with the weight of the spring leaves on it. The type of trailer shown will permit the handling of 18 spring sets at one time.



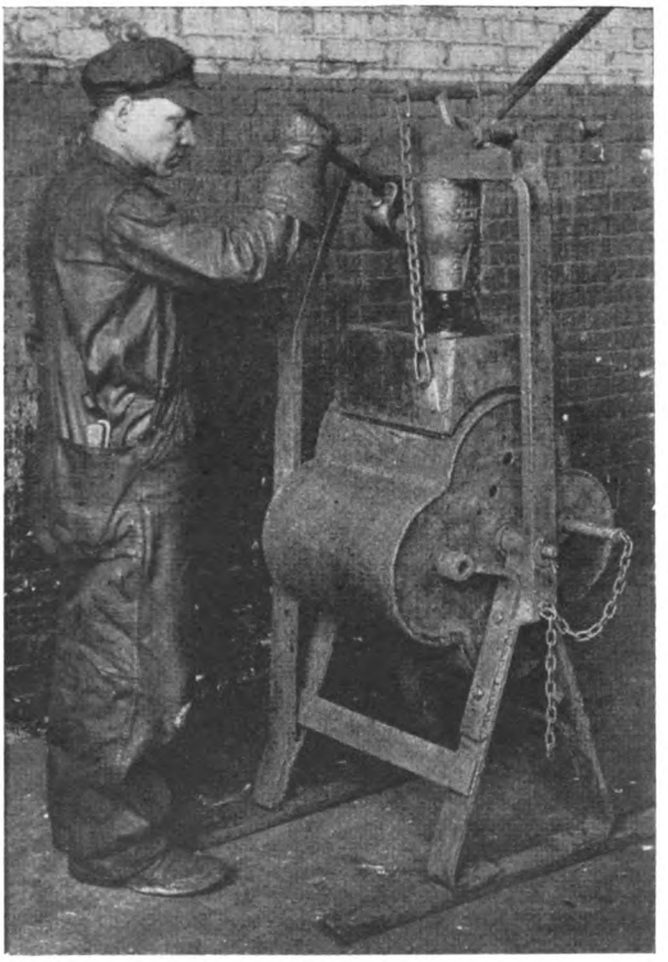
A car for moving locomotive springs to the banding machine

Clover-Leaf Grease Press

A SPECIAL hard-grease press is used at a number of shop and enginehouse points on the Chicago, Rock Island & Pacific, being appropriately called the Clover-Leaf press, because of its shape. This device forms a convenient and effective means of applying a cake of hard grease to the perforated copper cellar plate which bears against the journal, sufficient pressure being applied so that the grease is forced through the small holes in the same direction in which it will flow when in service, thus assuring necessary and uninterrupted main journal lubrication when locomotives are first turned out of the shop. This method avoids the present more or less common practice of attempting to fill the perforated plate holes with grease from the outside by means of a hand paddle after the main grease cake has been applied. As a result, the application is not uniform and there is a tendency to create a division in the grease with consequent interruption of the flow of lubricant.

The Clover-Leaf grease press is a bolted and welded steel structure, 60 in. high overall, by 24 in. wide, mounted on supporting legs which are bolted to two floor strips made of 1-in. by 2½-in. steel, 36 in. long. A Buda 25-ton hand jack is welded in an inverted position to the top of the cross rail of the device, being operated by the usual removable round lever or bar. The drum of the machine is 16 in. long on the axis and designed with an exterior surface to accommodate four different diameter sizes of driving-box grease cellars, namely 10-in., 11-in., 11½-in. and 12-in. The drum is a completely-welded structure, made of ¼-in. plate and provided with positioning pins, as shown. By means of two adapting plates, the additional sizes of 9-in. and 12½-in. cellars can also be accommodated.

In operation, a false cellar with the bottom cut out and a perforated plate and hard grease cake inserted, is applied over the proper size segment of the drum. A close-fitting steel plate is put in the false cellar on top of the grease cake and operation of the jack then forces this grease through the perforated holes. With the jack still applied, operation of the upper bar and lever arrangement lifts the dummy cellar by means of the two chains attached to welded lugs, as illustrated. The pressure on the jack is then released and the perforated plate and grease cake removed, being ready for application in the standard driving-box cellar. A generous proportion of the grease has been forced through the perforated holes to the inner diameter of the copper plate which bears against the under side of the journal. The cellar and plate are, therefore, well filled with grease and ready to provide immediate lubrication.



Clover-Leaf press used in forcing hard grease through holes in the perforated copper plates used in driving-box cellars

Among the Clubs and Associations

NEW ENGLAND RAILROAD CLUB.—The annual meeting and election of officers of the New England Railroad Club was held on March 13.

NORTHWEST CAR MEN'S ASSN.—At the March 5 meeting of the Northwest Car Men's Association, original record of repairs and A. R. A. billing was discussed by George Johnson, chief clerk to master car builder, Northern Pacific.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—T. Sawyer, Diesel Electric Division, American Locomotive Company, presented a paper on Diesel electric locomotives at the March 15 meeting of the Southern and Southwestern Railway Club.

CANADIAN RAILWAY CLUB.—"Recent Progress in the Design and Construction of Locomotive, Freight and Passenger Equipment" was the subject discussed before the March 12 meeting of the Canadian Railway Club by a representative of the Pullman Company.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Meeting held Monday evening, March 12, at the Hotel LaSalle, Chicago. Proposed changes in the A. R. A. Rules of Interchange were considered, the discussion being led by R. A. Forbes, chairman of the A. R. A. Rules Committee and assistant superintendent of the Chicago Car Interchange Bureau.

Prospects of the Railway Supply Industry

Western Railway Club.—Meeting held Monday evening, February 19, at the Hotel Sherman, Chicago; subject, "Prospects and Problems of the Railway Supply and Equipment Industry"; speaker, Samuel O. Dunn, chairman of the board of the Simmons-Boardman Publishing Company and editor of Railway Age. ¶ In this address, the speaker quoted impressive general figures, indicating the magnitude of the railway supply industry, and said that the volume of future purchases will depend upon railway gross and net earnings as influenced by government policies and the revival of general business. He called attention to the difference between the capitalistic and the socialist-labor philosophies, and said that the latter is now apparently dictating the economic policies of the national government. Assuming that the rights and interests of wage earners are not to be permanently treated as entirely paramount to those of investors and business men, Mr. Dunn said: "There is, in my opinion, no reason for doubting that, in the absence of excessively socialistic and restrictive government economic policies, the total volume of production and commerce in this country will again expand until, within a few years, it will exceed all previous records. It also seems probable that government policies will be adopted which will greatly reduce present inequalities in the conditions under which the railways must compete with other agencies of transportation. In that case the railways will be confronted with the necessity of both rehabilitating their properties and of so improving them as to enable them to nullify the advantages now enjoyed by their highway competitors which are due to the physical characteristics of motor vehicles. Never within our time has there accrued so much railroad obsolescence and deferred maintenance as has been caused by the reductions of capital and maintenance expenditures during the last three years. Never have the railways been confronted with competition requiring such changes in their facilities to enable them to hold and recover their passenger and freight traffic. In view of these plain facts, it would appear that a revival of general business is certain to cause a very large increase for some years to come in the business of the railway supply and equipment companies, and that their greatest problem and, also, their greatest opportunity will be to show the inventive genius and initiative necessary to enable them to provide the railways with the improved equipment and other facilities required to enable the railways adequately to reduce their operating expenses and, at the same time, adequately to improve their service."

Directory

The following list gives names of Secretaries, dates of next regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 2205, 150 Broadway, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—Division V.—MECHANICAL.—V. R. Hawthorn, 59 East Van Buren street, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorn, Chicago.

DIVISION VI.—PURCHASE AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Columet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, Room 332, 30 Church street, New York.

MACHINE SHOP PRACTICE DIVISION.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—Edgar J. Kates, 1350 Broadway, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, La Salle Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth street, Council Bluffs, Iowa. Regular meetings, second Tuesday of each month at Council Bluffs.

CENTRAL RAILWAY CLUB OF BUFFALO.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month except June, July and August, at Hotel Statler, Buffalo.

CLEVELAND RAILWAY CLUB.—F. B. Frericks, 14416 Alder avenue, Cleveland, Ohio. Meetings temporarily suspended.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon, 12:15 p. m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha street, Winona, Minn.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN.—C. L. Roberts, R. F. D. 5, Peoria, Ill.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md. Annual meeting October 17-18, Hotel Stevens, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver buiding, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TORONTO RAILWAY CLUB.—N. A. Walford, district supervisor car service, Canadian National, Toronto, Ont. Meetings first Friday of each month except June, July and August.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—C. L. Emerson, 822 Straus Building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

NEWS



THE BOSTON & MAINE is inquiring for 20 passenger coaches.

The Erie is inquiring for eight combination passenger, baggage and mail cars.

THE NEW YORK, NEW HAVEN & HARTFORD has issued inquiries for a streamlined train.

THE GULF, MOBILE & NORTHERN is inquiring for 50 gondola cars and from 150 to 200 box cars, all of 50 tons' capacity.

THE CLEVELAND, CINCINNATI, CHICAGO & ST. LOUIS has awarded a contract to the Walsh Construction Company, Chicago, for the renewing of the roof of this company's 35-stall enginehouse at Indianapolis, Ind. This work will involve an expenditure of about $35,000.

THE NATIONAL RAILWAYS OF MEXICO have ordered two 2-6-6-2 simple Mallet type locomotives from the American Locomotive Company. These locomotives, weighing 206,000 lb., will have 15-in. by 22-in. cylinders, a steam pressure of 210 lb., and maximum tractive effort of 41,100 lb.

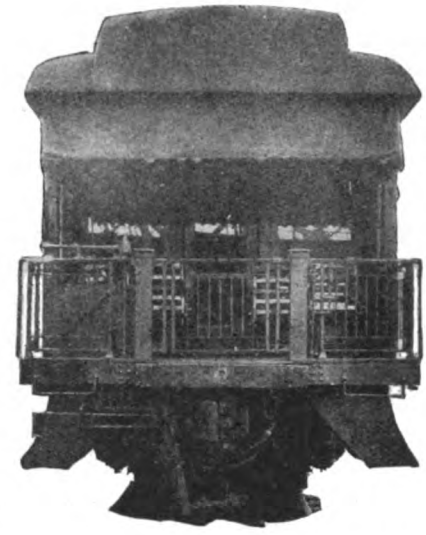
THE UNION PACIFIC has placed an order with the Pullman Car & Manufacturing Corporation for three additional streamlined articulated aluminum passenger trains. One is a six-car train composed of mail and baggage cars, a 56-seat coach and 3 Pullman sleeping cars and propelled by a 900-hp. Diesel engine. The other two are nine-car units, each with mail and baggage cars, coaches and sleeping cars, and propelled by 1,200-hp. Diesel engines.

One Locomotive and 1,879 Freight Cars Placed in Service Last Year

THE RAILROADS of the United States placed 1,879 new freight cars in service in 1933, according to reports received by the Car Service Division of the American Railway Association. In 1932, reports showed that 2,968 new freight cars were installed. The railroads on January 1, 1934, had 224 new freight cars on order compared with 2,431 on the same day last year. The railroads placed only one new locomotive in service in 1933 compared with 37 in 1932. Only one new locomotive was on order on January 1, this year, compared with three on the same day last year.

Interest in Air Conditioning Spreading Rapidly

SINCE THE FIRST of the year much interest has been shown in the installation of air-conditioning equipment in various types of passenger cars. The rapidity with which this interest is spreading is evident from the increasing number of orders which have been placed during the past month, as tabulated below. With the consummation of its improvement program, which will involve an expenditure of approximately $1,000,000, including the cost of 18 new all-steel cars, the principal passenger trains of the Norfolk & Western will have been completely air conditioned, while all of its passenger trains, including those assigned to branch-line services, will have been completely equipped with all-steel cars.



Recent Orders for Air-Conditioning Equipment

Road	No. of cars	Type of car	Type of system	Builder
A. T. & S. F.	2*	Cafe-obser.	Steam-ejec.	Safety Car Htg. & Ltg. Co.
	8*	Club		
	17*	Pull. obser.-sleep.		
	13*	Pull. sleeper		
C. & O.	4	Imp. lounge	Mech.	P. C. & M. C.
C. & N. W.	2	Obser.-sleep.	Ice	P. C. & M. C.
	2	Limousine-parlor	Ice	
	2	Lounge-obser.	Mech.	
	1	Sleeper	Mech.	
	1	Obser.-sleep.	Mech.	
	1	Obser.	Mech.	
	2	Club	Mech.	
	10	Dining	Mech.	To be installed in company shops
	2	Obser.-cafe-lounge		
	2	Lounge		
N. & W.	4**	Coaches	Steam-ejec.	Safety Car Htg. & Ltg. Co.
	6**	Coaches	Elec.-Mech.	Frigidaire Corp.†
	8**	Comb. pass. & bagg.	Elec.-Mech.	Westinghouse-Sturtevant†
	43	Coaches	.....	.....
	19	Pull. cars	.....	.....
	6	Diners	Elec.-Mech.	Frigidaire Corp.†
S. A. L.	2‡	Diners	Mech.	P. C. & M. C.
	1‡	Parlor		
Union Pac.	22	Obser.	Mech.	P. C. & M. C.
	16	Diners		

* These are in addition to the 26 cars reported in the February issue.
** These are new all-steel cars, an order for which has recently been placed with the Bethlehem Steel Company. They will have a length over-all of 84 ft. 2¾ in., 4 ft. longer than N. & W. coaches now in use. They will have women's and men's lounges, deep-cushioned, double-spring, rotating seats, indirect lighting and other conveniences. The coaches will have a seating capacity of 60 passengers—44 in the main body of the car, six in the women's lounge and ten in the men's lounge. The combination passenger and baggage cars, with a seating capacity of 29, will be similarly equipped.
† Safety axle-driven power plants.
‡ These are in addition to the 15 cars reported in the February issue.

P. W. A. Loans to Railroads

IN VIEW of the exhausted status of the public works fund, the Public Works Administration on February 23 announced a policy of hereafter considering for allotment only projects of public bodies and railroads subject to the interstate commerce act. The P.W.A. will continue to make loans to railroads for the purchase of rails and for equipment because of the semi-public nature of the carriers, it announced, and because loans of this character are considered particularly desirable because they are quickly transformed into payrolls and are an important factor in the program to afford relief to the heavy industries. Although the $3,300,000,000 fund has been allotted, from time to time there remains a small unallotted balance due to revocations, withdrawals and reductions and funds thus returned are at once allotted for expenditure elsewhere.

Public Works Administrator Harold L. Ickes announced on March 1, that he had signed two more contracts for railroad loans totalling $2,693,000. This puts under contract $136,889,000 of the $196,607,800 allotted by the P. W. A. for railroad loans. Contracts covering the balance of the fund are in course of preparation.

Since the publication of the February *Railway Mechanical Engineer* the following contracts, allotments or changes have been made:

Chesapeake & Ohio.—The loan to this road for the purchase of the equipment as listed in the January issue has been

reduced from $18,290,000 to $16,876,000.

Boston & Maine.—The program just announced by this road, details concerning which have been under discussion for some weeks, totals $7,318,000, of which $3,719,000 will be expended for the purchase and repair of equipment as follows: Three 800-hp. Diesel-electric passenger units, each capable of hauling four trailers, a Diesel-electric switching locomotive, five Mountain type locomotives for both freight and passenger service, five Pacific type locomotives for passenger service; 10 de luxe air-conditioned passenger coaches, and 21 modern suburban coaches—total, $2,628,000; and for repairs to equipment, including the air-conditioning of the de luxe passenger coaches and diners on several of its principal passenger trains and the installation of de luxe-type reclining seats in 10 passenger coaches—$910,000. The latter amount also provides for the continuation at Billerica of repair work on locomotives, box and coal cars and passenger which was begun in December.

Chicago, Milwaukee, St. Paul & Pacific.—This road has applied to the Interstate Commerce Commission for the necessary authorizations for a loan of $5,720,000 for the purchase of equipment, for which no allotment had yet been announced by the P. W. A., and also for another loan of $2,917,383 to take the place of its previous application for $1,818,750 for rails and fastenings which had been withdrawn. The company applied for authority to assume obligation and liability in respect of equipment trust certificates for 25 all-steel baggage-express cars at an estimated cost of $456,000; 50 all-steel passenger coaches, equipped for air-conditioning, $1,260,000; and 30 high-speed 4-8-4 type locomotives, $4,004,000. Prices have been asked on the 30 locomotives. The additional loan of $2,917,383 for which application was filed with the P. W. A. on January 24 is for the purchase of 20,000 tons of rails, together with fastenings and accessories, $2,066,852; strengthening bridges and lengthening turntables and engine stalls to accommodate the new locomotives, $600,000; air-conditioning 22 dining and lounge cars, $136,000; and the purchase of 300 Evans auto-loaders, $114,531. The previous application had been for the purchase of 50,000 tons of rails.

Delaware, Lackawanna & Western.—$4,666,000 has been alloted to this road and will be used for the following new equipment and rebuilding programs: The purchase of 20 locomotives of the 4-8-4 type, 5 oil-electric locomotives, and 500 steel hopper cars. In connection with the latter separate bids are being requested on cars of 50 tons' capacity and on others of 70 tons' capacity. Inquiry is also being made on the new locomotives.

The rebuilding program calls for converting 986 wood-sheathed box cars into all-steel cars and converting 20 road engines into switching engines. The schedule of work calls for turning out 100 rebuilt box cars and 1 rebuilt locomotive per month.

Erie.—The loan of $11,964,000 to this road, as noted in the January issue, has been reduced to $11,282,000. The Erie also has asked for authority to issue $623,000 of 10-year serial notes to the P. W. A. for the conversion of 750 gondola cars into hopper cars.

Gulf, Mobile & Northern.—An allotment of $1,000,000 to this road will be used for the purchase of 200 freight cars at an estimated cost of approximately $500,000 and passenger equipment to cost about the same. The passenger equipment, which has not yet been ordered, may be of the new high-speed, streamline type, depending on operating results shown by trains now being tested on several other roads.

Illinois Central.—$7,310,855 of this road's loan will be spent for repairing and overhauling 12,645 freight cars, 184 passenger-train cars, and 148 engines in its own shops. This amount, together with $1,438,145 for rails, makes a total of $8,748,000. A somewhat different list of equipment was given in the January issue, also an allotment of $9,300,000.

Lehigh & New England.—The contract with this road is for a loan of $1,212,000 for the purchase of 500 new freight cars. Orders for this equipment were placed, subject to confirmation after execution of the contract, 100 from the American Car & Foundry Company, 150 from the Pressed Steel Car Company, and 250 from the Magor Car Company.

Lehigh Valley.—This road is inquiring for some 4-8-4 type locomotives. It has applied to the P. W. A. for a loan of $600,000 for the purchase of five locomotives and tenders.

Northern Pacific.—The loan of $1,220,000 to the Northern Pacific is to be used for the purchase of the 10 new locomotives ordered from the Baldwin Locomotive Works, as noted in the January issue. The original allotment to this road for this equipment was $1,252,000.

Pennsylvania.—Orders have been placed with the National Malleable & Steel Castings Company for type B trucks to be used on 250 cars of 50 tons' capacity which the railroad is building in its own shops, and with the Westinghouse Air Brake Company, Wilmerding, Pa., for 7,000 complete sets of the new Schedule "AB" freight car air brake equipment to be used on the 7,000 freight cars to be built by the railroad as part of its recently announced improvement and employment program, financed with a P. W. A. loan.

Seaboard Air Line.—Application has been made for a loan for the purchase of 5 locomotives, 1,000 box cars and 100 phosphate cars.

Southern Pacific.—The program of this road includes the rebuilding, repair and modernization in its own shops of 748 locomotives, 3,811 freight cars and 406 passenger-train cars.

Pittsburgh & West Virginia.—An allotment of $331,000 to the P. & W. Va. is for the purchase of three new heavy freight locomotives of the articulated type. These locomotives were provisionally ordered from the Baldwin Locomotive Works subject to confirmation of a loan contract with the P. W. A. and the approval of the Interstate Commerce Commission.

The original allotments to the C. & O., the Erie and the Northern Pacific were made on the basis of the estimated cost of the equipment, but since then competitive bids were obtained which were lower than the estimated costs.

Applications for loans or allotments not previously mentioned in these columns for the purchase of equipment other than cars and locomotives have been made as follows: Boston & Maine, $2,018,000; Pennsylvania, $3,650,000; New York, Ontario & Western, $235,000; Erie, $2,048,498; Wisconsin Central, $115,000. Of the $4,230,000 allotment to the B. & O., reported in January, $1,500,000 is for the purchase of rail and track fastenings.

Supply Trade Notes

THE WESTINGHOUSE AIR BRAKE COMPANY will move its New York office, about May 1, from 150 Broadway to the Empire State building, Fifth avenue and Thirty-Third street, New York.

FRANK B. MACMILLIN has been elected president and general manager of the Hydraulic Press Mfg. Company, Mt. Gilead, Ohio; Howard F. MacMillin, vice-president and assistant general manager; and Walter G. Tucker, chairman of the board.

H. H. LINTON has been appointed eastern sales representative for the W. N. Thornburgh Manufacturing Company, Cicero, Ill. Mr. Linton's headquarters are in the Grand Central terminal, New York City.

THE PERSONNEL of the Union Steel Casting Company, Pittsburgh, Pa., a subsidiary of Blaw-Knox Company is now as follows: Jan R. Dunsford, chairman of the board; Frank Cordes, president; D. V. Sherlock, manager; William P. McGervey, Jr., assistant to the president. Sales are handled by Robert H. Cunningham, sales manager; Walter H. Eisenbeis, assistant sales manager; John N. Critchlow and Grant W. Lillie.

HAROLD B. RESSLER, vice-president in charge of sales of Joseph T. Ryerson & Son, Inc., Chicago, has been transferred to New York to take charge of the company's Jersey City plant and will take over the duties of J. A. McNulty, who has resigned as manager of the Jersey City plant.

THE INGERSOLL-RAND Company, New York, has acquired the turbo-blower business of the General Electric Company and will consolidate it with its own turbo-blower department. The manufacturing equipment previously employed by General Electric is being moved to Ingersoll-Rand's Phillipsburg, N. J., plant where all types and sizes will be manufactured. Sales activities will be directed from Ingersoll-Rand Company's general offices at 11 Broadway, New York.

(Turn to next left hand page)

UNBALANCED FORCES
TEAR AWAY AT ENGINE BOLTS



Engine bolt material is subjected to tremendous strains due to the unbalanced forces that work from one side of the locomotive to another. » » » Engine bolt steel must refuse to give a fraction of an inch or else cracks develop from the pounding which soon has the locomotive in the shop. » » » Years ago, the metallurgists of Republic Steel Corporation began their research for a steel that would withstand repeated shocks; possess higher tensile strength and that would resist fatigue better than the old steels but still retain the uniformity of composition that makes steel desired over wrought iron. » » » From years of patient development in the country's largest metallurgical laboratories has come Agathon Engine Bolt Steel—a steel that possesses the desired fatigue resistance, ease of machining and ductility. » » » So well does this steel supply the demands for a better engine bolt material that many large railroads have standardized on it. » » » »

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CENTRAL ALLOY DIVISION, MASSILLON, OHIO

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES YOUNGSTOWN, OHIO

AGATHON STEELS

F. STANLEY JONES has been appointed sales manager of wire products, W. H. Messner sales manager of rolled products, and George Tritch assistant manager of sales for the steel division of the Colorado Fuel & Iron Products Company, Denver, Colo.

THE SUBSIDIARY manufacturing companies of the United States Steel Corporation have organized and established a Railroad Research Bureau to engage in developmental work for the benefit of the railroad and railroad supply industries. John A. Ralston is manager of the bureau, which has its headquarters in the Frick building annex, Pittsburgh, Pa. Engineering and experimental work of this department will be closely co-ordinated with the activities of the subsidiary manufacturing companies, in the interest of rendering service to all who are concerned with the application of rolled steel products to the construction of railroad equipment. A series of high tensile steels are being produced and offered to the trade by the companies co-operating in and with the Railroad Research Bureau. Grades and products suitable for a variety of requirements are available for the execution of new designs, which have as their purpose a reduction in weight without attendant sacrifice of strength.

EVERETT CHAPMAN, who joined Lukenweld, Inc., division of Lukens Steel Company, Coatesville, Pa., early in 1930 as director of engineering and research, has been elected vice-president. Lukenweld,



Everett Chapman

Inc., is engaged in the design and manufacture of welded steel assemblies for machinery and equipment. After graduation in 1924 from the University of Michigan, with a master's degree in physics, Mr. Chapman taught electrical engineering at Purdue University, leaving to serve the Lincoln Electric Company of Cleveland, Ohio, on experimental research and development. Since joining Lukenweld, Inc., Mr. Chapman has been credited with responsibility for that organization's engineering achievements in the application of welded steel construction to Diesel engines, presses, planers, lathes, and other machinery and equipment.

PERRY T. EGBERT has been appointed manager of the newly formed Railway Diesel Sales division of the American Locomotive Company with headquarters at 30 Church street, New York. Mr. Egbert will have charge of all sales of Diesel-electric locomotives and of Diesel or gasoline engines for self-propelled rail units and parts therefor. Mr. Egbert started his business career in 1911 as a special apprentice in the Sayre shops of the Lehigh Valley. In 1914 after the completion of this course he occupied various positions with several railroads, leaving the Norfolk & Western in April, 1917, to join the United States Army as an aviator. After being mustered out in July, 1919, he returned to Cornell University, where he received his education, as an instructor in experimental engineering, remaining there until June, 1920, when he entered the employ of the American Locomotive Company in the engineering department at Schenectady, N. Y. Late in the fall of the same year he was transferred to the foreign sales department, and in the spring of 1921 became the representative of the Company in China. Returning to the United States in the fall of 1924, Mr. Egbert became attached to both the domestic sales and manufacturing departments of the American Locomotive Company, with duties confined to the development of new work. Late in 1929, following the acquisition of the McIntosh & Seymour Corporation, the Diesel Engine division of the American Locomotive Company, he was assigned to the McIntosh & Seymour Corporation as the American Locomotive Company representative for the developing of a Diesel engine particularly suited for railway work. Upon the completion of the design he was given full charge of the developing and servicing of the Alco Diesel locomotives, which position he held until his recent appointment. Mr. Egbert, with his new position, will still retain charge of the service bureau.

Obituary

JAMES MCLAUGHLIN, district manager of the Franklin Railway Supply Company, Inc., with headquarters at San Francisco,



James McLaughlin

Cal., died in the French hospital, San Francisco, on February 7, after a short illness. Mr. McLaughlin had served in the supply business in the East with the American Locomotive Company for about three years previous to 1913, when he entered the service of the Franklin Railway Supply Company and had taken an active part in the affairs of the A. R. A., Mechanical Division. On April 1, 1921, he was appointed district manager of the Franklin Railway Supply Company, Inc., assigned to the Pacific Coast territory, with headquarters at San Francisco.

EDWARD JAMES KEARNEY, secretary-treasurer of the Kearney & Trecker Corporation, Milwaukee, Wis., died of pneumonia on January 12. Mr. Kearney was 66 years of age at the time of his death.

WINFIELD H. DAVIS, eastern representative of the Spring Packing Corporation, Chicago, with headquarters at Cleveland, Ohio, died in that city on February 4 after a month's illness.

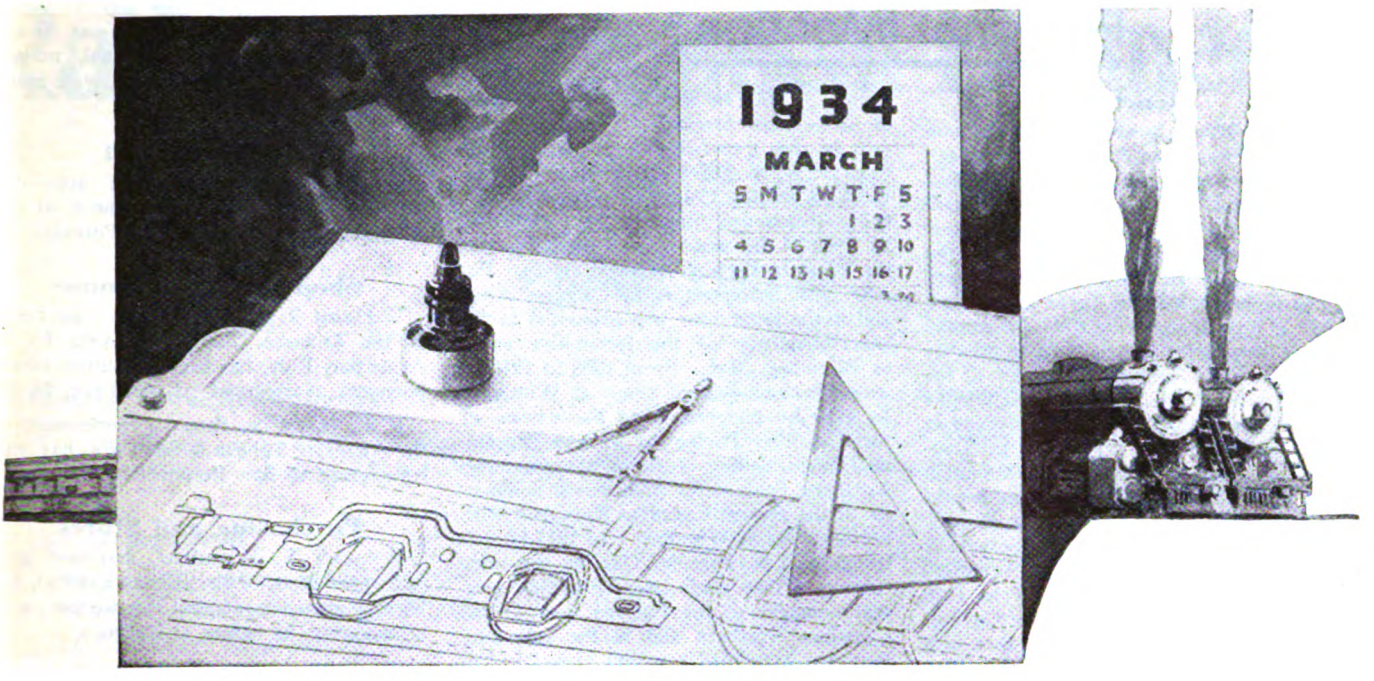
ARTHUR S. LEWIS, district sales manager of the Barco Manufacturing Company, Chicago, with headquarters at New York, died at St. Petersburg, Fla., on February 10.

I. ORVILLE WRIGHT, sales engineer and Baltimore (Md.) representative of The Symington Company, New York, died at the Memorial hospital in Baltimore on January 28 after an illness of several months. Mr. Wright was born at Union Bridge, Md., on March 12, 1872. He attended Quaker and private schools there until the age of 17, when he began work at the Western Maryland shops in that town, spending four years as machinist apprentice. While learning his trade, he attended night school and studied mechanical drawing. He later qualified as a draughtsman for the Western Maryland. In this position he conceived the idea of an improved buffer and attachment for



I. Orville Wright

freight car couplings, and what was later to be known as the Farlow draft gear was invented. In 1899 he served with the South Baltimore Car Works as draughtsman. Shortly afterward, with the help of the late John H. Farlow, then general manager, he marketed his device, giving it the name of Farlow spring draft gear. The Farlow Draft Gear Company was absorbed in 1908 by The T. H. Symington Company. Mr. Wright continued with The T. H. Symington Company and subsequently its successor The Symington Company, up to the time of his death.

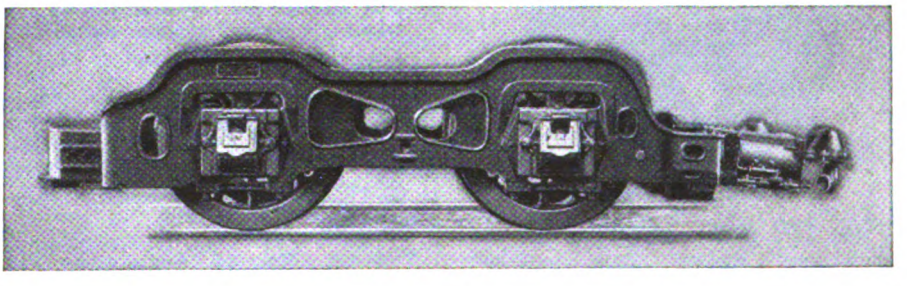


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FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

Personal Mention

General

CLYDE B. HITCH, general master mechanic of the Chesapeake & Ohio at Huntington, W. Va., has been appointed assistant superintendent motive power, with headquarters in the same city, and the position of general master mechanic at that point has been abolished. Mr. Hitch was born on November 4, 1882, at Terre Haute, Ind. After a high school education he entered railway service as a machinist apprentice on the Vandalia Railroad (now part of the P. R. R.) at Terre Haute, completing his apprenticeship in 1900. He later served as machinist on the Pere Marquette, the Louisville & Nashville, the Iron Mountain (now part of Missouri Pacific), the Southern and the Chicago & Eastern Illinois. He entered the service of the Chesapeake & Ohio in 1902 as machinist at Lexington, Ky. He subsequently served from 1910 to 1913 as general foreman of the Covington shops at Covington, Ky., and then in a similar position at the Hinton, W. Va., shops until 1920. From the latter date until 1923, Mr. Hitch was master mechanic at Clifton Forge, Va., then being transferred to the Cincinnati and Northern divisions in the same capacity. He next served as master mechanic of the Cincinnati, Northern and Russell divisions, with headquarters at Russell, Ky., and in May, 1930, was appointed general master mechanic at Huntington, W. Va.

SAMUEL J. HUNGERFORD, who has been acting president of the Canadian National Railways since the retirement of Sir Henry Thornton as president and chairman in July, 1932, and who has during the intervening period continued to perform the duties of operating vice-president of the properties, has been chosen president of the company.

Mr. Hungerford was born near Bedford, Que., in 1872 and entered railway service



Samuel J. Hungerford

in 1886 as a machinist apprentice on the Southeastern Railway (now Canadian Pacific) at Farnham, Que. Completing his apprenticeship in 1891, he worked at his trade at various places in Quebec, Ontario and Vermont for the Canadian Pacific. In 1894 he became chargeman for the same company at Windsor street, Montreal. Three years later he was promoted to the post of assistant foreman at Farnham shops. In 1900 he went to Megantic, Que., as locomotive foreman. The following year he was transferred to McAdam Junction, N. B., as general foreman. He then went to British Columbia for two years, being locomotive foreman at Cranbrook. In 1903-04 he was master mechanic for the Western division of the Canadian Pacific with headquarters at Calgary, Alta., and in the latter year was promoted to the superintendency of the locomotive shops as Winnipeg, Man. From 1908 to 1910 he was superintendent of shops at Winnipeg. In 1910 he resigned from the service of the Canadian Pacific to become superintendent of rolling stock of the Canadian Northern (one of the predecessor companies of the present Canadian National) with headquarters at Winnipeg. In 1915 he was transferred to Toronto, Ont., in the same capacity. Two years later he became general manager of the Eastern lines of the Canadian Northern and in the following year was appointed assistant vice-president of operation, maintenance and construction of the Canadian National, then in process of formation as successor to the Canadian Northern, with the same headquarters. In 1920 he became vice-president of operation, maintenance and construction of the Canadian National and Grand Trunk Pacific. In 1922 he was appointed vice-president and general manager of the two companies and, upon their merger into the present Canadian National System in 1923, he became vice-president of operation and construction of the system with headquarters at Montreal, in which position he remained until he was chosen also as acting president of the system in 1932.

Master Mechanics and Road Foremen

J. M. NICHOLSON, master mechanic of the Atchison, Topeka & Santa Fe at Slaton, Tex., has been transferred to Argentine, Kan., to succeed W. R. Harrison.

W. P. HARTMAN, fuel supervisor of the Atchison, Topeka & Santa Fe at Amarillo, Tex., has been appointed master mechanic of the Slaton division, with headquarters at Slaton, Tex.

Car Department

U. L. SWEENEY has been appointed general supervisor car department of the Richmond, Fredericksburg & Potomac.

Shop and Enginehouse

WILLIAM R. HARRISON, master mechanic on the Atchison, Topeka & Santa Fe, at Argentine, Kan., has been appointed superintendent of shops at Albuquerque, N. M.

F. B. HARMAN, shop superintendent of the Atchison, Topeka & Santa Fe, has been transferred to San Bernardino, Cal.

Purchasing and Stores

WILLIAM S. MOREHEAD, assistant general storekeeper of the Illinois Central, has been promoted to general storekeeper, with headquarters as before at Chicago.

W. A. CLEM, assistant purchasing agent of the Reading, has had his jurisdiction extended to include the Central of New Jersey. Mr. Clem's headquarters are at Philadelphia, Pa.

Obituary

WILLIAM DAVIDSON, general storekeeper of the Illinois Central, with headquarters at Chicago, died suddenly of a heart attack on February 22.

EVAN H. WADE, who retired in 1927 as assistant superintendent of motive power of the Chicago & North Western, died on February 16 at the West Suburban hospital at Chicago at the age of 64 years.

WILLIAM A. HOPKINS, who was general purchasing agent of the Missouri Pacific Lines until his appointment as consulting purchasing agent on September 1, 1933, died at the Missouri Pacific Hospital at St. Louis, Mo., on January 7.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

MACHINABILITY OF STEEL.—The effect of cold drawing and the results of annealing are discussed in a four-page folder entitled "Making Steel Machinable" issued by the Union Drawn Steel Company, Massillon, Ohio.

TRIPLE-A No. 44 ALUMINUM.—The Quigley Company, 56 West Forty-Fifth street, New York, describes and illustrates in a six-page folder applications of Quigley Triple-A No. 44 black anti-corrosive vehicle for aluminum coatings.

CARBOLOY COST-SAVING TOOLS.—In its booklet "Carboloy Cost-Saving Tools" the Carboloy Company, 2481 East Grand Boulevard, Detroit, Mich., suggests applications of Carboloy tools of various types, summarizes savings reported by Carboloy tool users, and illustrates a few representative types of tools made at its Detroit plant.

LJUNGSTROM AIR PREHEATER.—The Air Preheater Corporation (under management of the Superheater Company), 60 East Forty-Second street, New York, manufacturers of the Ljungstrom continuous regenerative counterflow air-preheater, has issued bulletin No. 933 which illustrates various applications of the Ljungstrom air preheater.

PARKER-KALON PRODUCTS.—Complete information and technical data relating to the use of various types of screws and nails for making fastenings to sheet metal and steel; to iron, brass and aluminum castings; to Bakelite, slate and other substances; for fastening sheet metal to wood, etc., are contained in the 36-page illustrated catalog issued by the Parker-Kalon Corporation, 200 Varick street, New York.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

April, 1934

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices,
30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: Terminal Tower
Washington: 832 National Press Bldg.
San Francisco: 58 Main St.

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Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States and possessions: 1 year, $3; 2 years, $5. Canada, including duty: 1 year, $3.50; 2 years, $6. Foreign countries: 1 year, $4; 2 years, $7.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.



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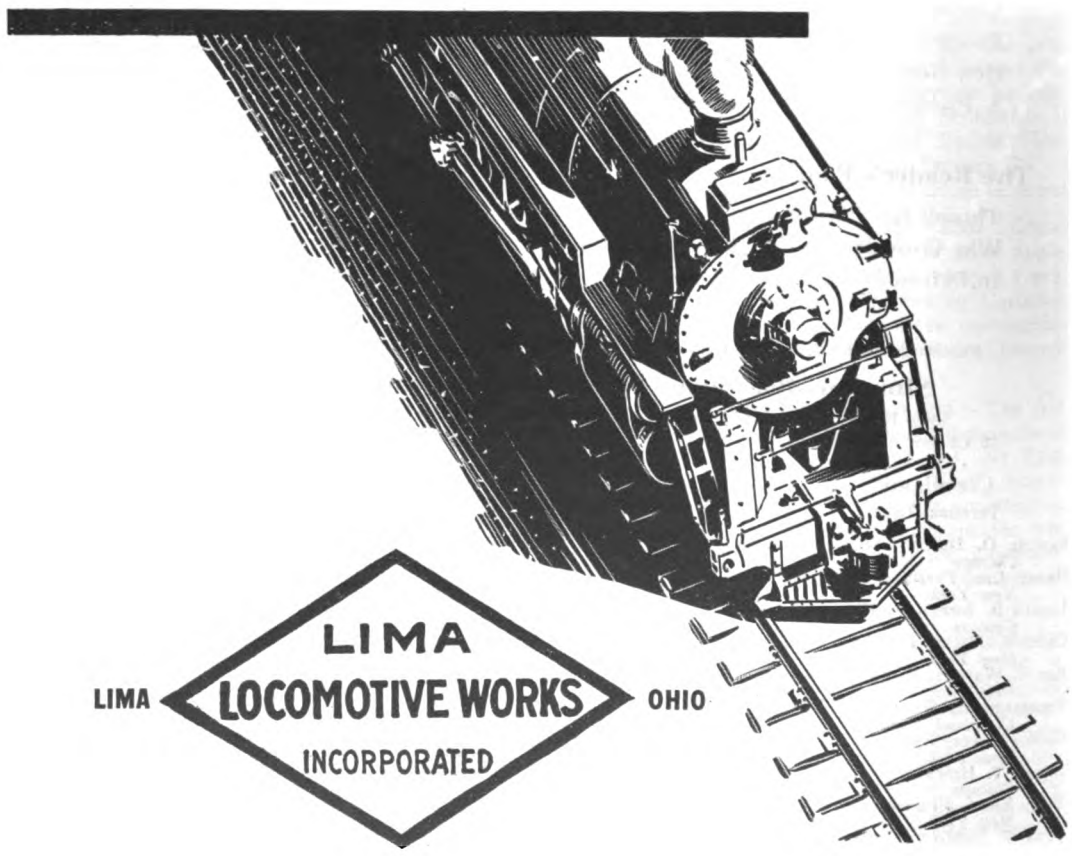
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Railway
Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

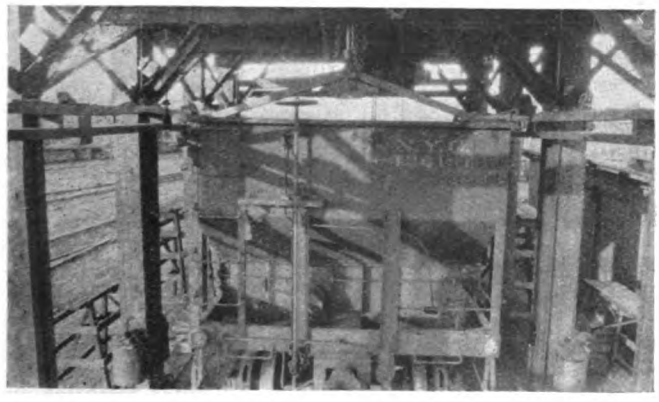
April - 1934

Progressive Repairing of Gondola Cars*

By J. W. Steck†

Description of system used by New York Central at the Avis shops

PRIOR to the inauguration of the present system of repairing open-top equipment, which, with certain modifications, has been in effect on the New York Central at Avis, Pa., since 1928, considerable study was given to different methods of repairing cars and, after careful consideration, it was decided that the progressive system offered the greatest possibilities. After using this system for more than five years in the repairing of all types of open-top equipment, receiving all classes of repairs, it is felt that the choice was a wise one as a substantial saving has been made in labor costs and this saving has not been effected at the expense of the earning capacity of the workmen. Material costs have also been substantially reduced, with the turn-over exceptionally fast.



Interior view of jack frame equipped with special facilities for straightening cars before they are stripped

The progressive system is just what the name implies. The cars are moved at different intervals during the day, depending upon production. It requires approximately 2½ min. to complete a moving, this time in many cases being utilized by the workmen in preparing for the next car. All cars on the entire track are moved as a unit by the use of an electric winch located at the head end of the track and is effected by the use of cables equipped with special hooks.

For the successful operation of the progressive system a complete knowledge of the condition of the equipment to be repaired must be had, it not being sufficient to know what the major items of repairs consist of, but the minor repairs as well, for without this information it would be impossible to determine accurately where the different operations should be performed in the most economical manner and how many men will be required in the different positions.

For open-shop equipment receiving heavy repairs, such as new floor system, side or complete new tops, two adjacent tracks running the entire length of the shop are used. This permits a sufficient number of positions on each track and eliminates the possibility of confusion by placing too many men in any one position and also permits the different operations to be performed in the most economical manner. As an illustration, it has been found that it is far more satisfactory to apply the floor in one position and ream in another than to combine both operations in one position.

General Description of the Car Shop

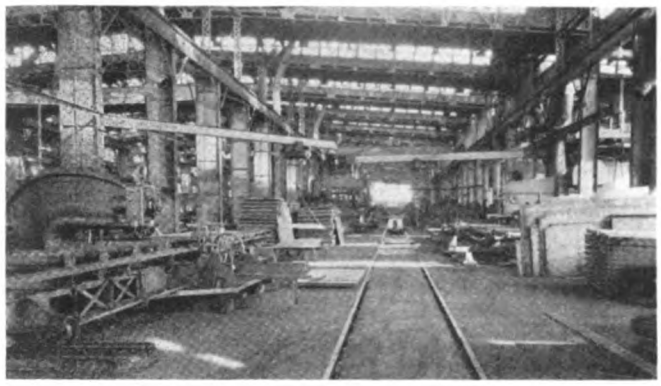
This shop, while not primarily designed for handling cars on the progressive system, is well suited for this method of repairing. The shop is 200 ft. wide by 700 ft. long, the entire floor area being covered with a wood-block floor, and consists of four bays, each bay being 50 ft. wide with three tracks running the entire length of the two principal bays.

Bay No. 1 is utilized for the repairing of cars and the storing of materials for the particular group of cars being repaired. The outside track is kept open at all

* Paper presented before the meeting of the Eastern Car Foremen's Association on January 29.
† Shop superintendent, Avis, Pa.

times for supplying material. The middle track is used for the storing of material opposite each position for use on cars being repaired on adjacent tracks. This bay is served by one 10-ton traveling crane and several small electric cranes operating on independent runways. These small cranes are used by the workmen for handling heavy materials, such as floors and side sheets in the fitting position, and by the truckmen for work pertaining to trucks. They are operated from the ground by the workmen in the various positions.

Bay No. 2, which also has three tracks, is served by one 10-ton and one 20-ton crane, the 20-ton crane being equipped with a 5-ton auxiliary hoist. The track adjacent to the erecting track in bay No. 1 is utilized for



Fabricating shop from west end showing completeness of equipment

cars receiving heavy repairs. A portion of the middle track is utilized for the placing of cars for scrap loading, while the third track in this bay is used for the repairing of cars by the progressive system receiving miscellaneous repairs, all work being completed on the one track.

The fabricating shop is located, in the west end of bay No. 3 the east end of the bay being utilized for storing material requiring fabrication. This bay is served by one 20-ton crane and, in addition, each principal machine is equipped with an electric hoist.

Bay No. 4 contains the planing mill, electric, air-brake and tool rooms. This bay is also used for repairing cabooses in the east end and, in the west end, gap riveting of car parts, such as doors, longitudinal hoods, tie bars, etc., a class of work which can be more economically performed by this method than by the use of an air hammer.

West of the car shop, separated by the transfer table, is located the wheel shop and the blacksmith shop. At the east end is located the classification yard with a capacity of 260 cars, the jack frame, and the paint shop.

As the cars are shopped in the train yard they are inspected and classified as to the repairs required. This information is furnished to the office and from records maintained the total number of each group of cars and the repairs required can be ascertained.

When instructions are received as to the group of cars which are scheduled for repairs, an actual inspection is made of a representative number to determine the material required. This information is then furnished the stores department who prepare requisitions covering the necessary material. The delivery dates on material requiring fabrication are so specified that the shop will have sufficient time to fabricate a portion of the material before it is required on the assembly track. The delivery dates of all other material are so specified that the material will be on hand when needed.

Material being received from the manufacturers requiring fabrication is unloaded by the stores department with the 20-ton crane and stored in the east end of bay No. 3 until such time as it may be required at the various machines. All other material not requiring fabrication is unloaded by the stores department in bay No. 1 and stored opposite the various positions where it is used.

In repairing open-top equipment the fabricating shop plays an important part in the success of the assembly track and, unless close supervision is given this department, serious trouble will be experienced in the assembly of cars. While new methods were being devised for the repairing of cars it was also essential that new methods be found for performing the different operations in the fabricating shop, and this has been effected in many cases by the proper location of the various machines, the installation of duplicators, spacing tables, special jigs and dies, and the elimination of unnecessary time in handling material from one machine to another. Approximately 80 per cent of all material entering into the repairs of the 70-ton cars now being overhauled is fabricated at the shop.

The track line-up is based on a production of 20 self-clearing hopper cars per day receiving complete new floor system, end and corner sheet reinforcements and all other necessary work on the body and trucks. It should be understood, however, that the line-up will vary according to the class of equipment being worked, the class of repairs and the production desired.

As the cars are received in the shop classification yard they are inspected to determine whether any straightening is required before the actual repairs can be started. If straightening is required, the cars are placed in the jack frame, where, by the use of special facilities operated by air such items as top, side and end angles, side



An 8-ton gas-electric truck with special platform transports material for positions 6 and 7

and end sills, side stakes, etc., can be straightened cold without being removed from the car.

By the use of this jack frame and other facilities an average of 10 hopper cars can be straightened in eight hours.

Four Positions Used for Stripping

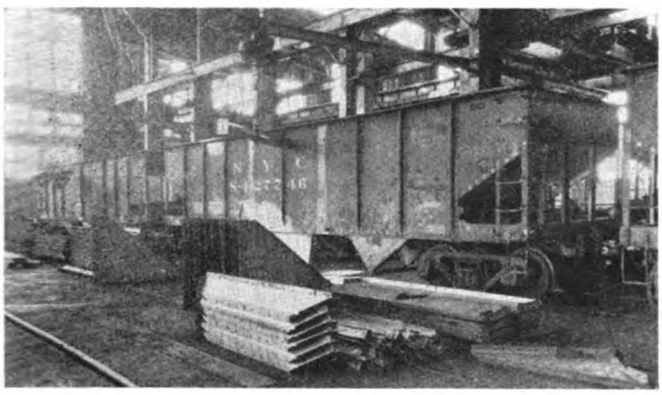
After the cars are straightened they are placed in the east end of the shop where the dope is pulled from the boxes, doors are opened and all dirt and rust removed that would interfere with the ripping of the floor by acetylene-burning outfits preparatory to removal. As the cars are required in the shop they are moved in by an electric winch located outside the shop.

In repairing cars 13 positions are required to perform all the different operations, seven of them being in bay No. 2 and six in bay No. 1 with two cars in each position. The illustrations show the cars at the start of the

work in that position rather than when the work is completed.

In the first position the cars are raised with the 20-ton overhead crane and placed on car horses. The cars are inspected and all defective parts marked for removal; the floors are ripped by the use of acetylene-burning outfits preparatory to removal; all defective parts, such as center plates, buffer castings, draft stops, brake shafts, etc., are removed, and the couplers and gears are dropped for inspection. All O. K. material—including train line—removed on account of other repairs is delivered to bay No. 1 where it is reapplied. All scrap material from this position is loaded in scrap boxes which are emptied by the overhead crane as required. After the work assigned to this position has been completed, the cars are replaced on their own trucks where they remain until the car reaches the truck position.

In the second position all rivets holding the floor to



Jib cranes supplement overhead cranes, position 7

the body of the car are removed by the use of acetylene-burning outfits equipped with special rivet-piercing tips. All other defective material, such as side stakes, sill steps and handholds are removed and parts which can be reclaimed are delivered to the blacksmith shop for repairs. In this position special trestles have been provided to eliminate unnecessary scaffolding.

In the third position the floors are removed with the overhead cranes, the scrap being loaded in cars directly opposite on the adjacent track. The scrap cars are changed each night by train crew after the shop has been closed for the day, it requiring approximately three high-side gondola cars for the scrap material accumulated from 20 cars receiving new floor systems.

In the fourth position all rivets which were not pulled out with the floor in the third position are backed out by the use of pneumatic tools.

The stripping of the car has now been completed.

Nine Positions Used for Assembling

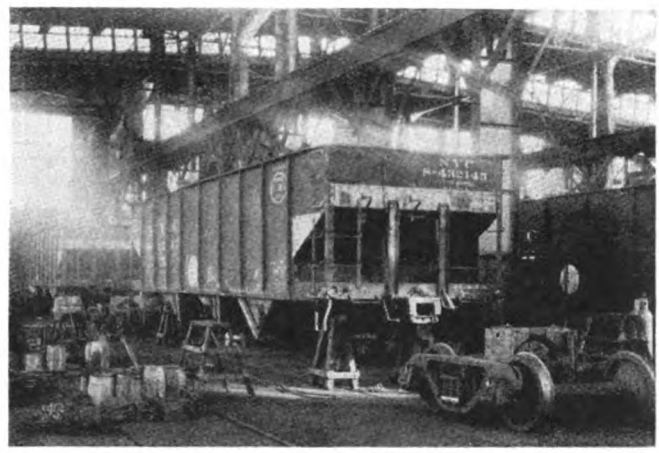
In the fifth position the interior and exterior of the car receive such cleaning as is necessary for painting when the repairs have been completed and all necessary parts of the car body are slush painted before new floors are applied. Permanent scaffolds have been erected in this position to eliminate loss of time and special facilities for the cleaning of the cars have also been provided.

In the sixth position the inside and outside hoppers, longitudinal hoods and bottom angles are applied. The hoppers are gaged with templets to insure correct door openings. The inside hoppers and longitudinal hoods are also reamed in this position to permit the riveting of these parts before the balance of the floor is applied. All material used in this position is stored on the adjacent track within easy reach.

In the seventh position, center floor sheets, gussets, side stakes and tie bars are applied with the aid of jib cranes equipped with an electric hoist located over the center of each car. The material used in this position is also stored on the adjacent track.

The cars, after the repairs have been completed in this position, are moved onto the transfer table and placed on the adjacent track in bay No. 1. In the eighth position the cars are raised by means of a small overhead electric crane operated by the workmen in this position and placed on car horses. The inside hoppers and the longitudinal hoods applied and reamed in the sixth position are driven, as well as all other miscellaneous driving, such as center plates, draft stops, buffer castings, etc. The trucks are inspected and all necessary work, including the repairing of boxes, is performed. The handling of defective truck sides, frames, bolsters and wheels is effected by the use of an overhead crane equipped with an electric hoist. After repairs have been completed the car body is placed on special car carriers fitted to the trucks, which elevate the body of the car. The cars are moved in this manner until they reach the last position on this track. These carriers avoid the necessity of raising and lowering the car in the remaining positions and make the bottom of the car easily accessible.

In the ninth position the floor sheets and angles, corner and end sheet reinforcements, inside and outside hopper reinforcements and door-shaft castings are applied.



Special carriers applied to trucks are used to elevate cars in positions 8 to 13

All material used in this position is stored on the adjacent track within easy reach of the overhead electric traveling cranes. The fitting of all car parts is effected by the use of special fitting-up bolts. To eliminate the necessity of scaffolding in the fitting, reaming and driving of end-sheet reinforcements, a special scaffold has been designed which remains on the cars until they reach the door position, by which time all the above-mentioned work has been performed.

In the tenth position the floors and reinforcements are reamed and all fitting bolts which were applied in the fitting position are changed, with the exception of those in the outside and inside hopper reinforcements and bottom angles, on which work is performed in the door position.

In the eleventh position all rivets are applied in the floor and reinforcements, except those parts not reamed in the tenth position.

In the twelfth position the doors are applied and drawn. Outside and inside hopper reinforcements and bottom angles are then fitted to the doors and reamed.

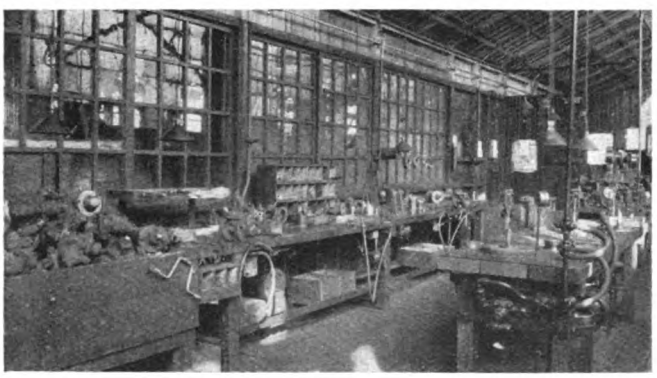
All material used in this position is also stored on the adjacent track. To eliminate confusion the cleaning and oiling of the cars is performed in this position while the balance of the air-brake work is taken care of in the last position.

In the thirteenth or last position inside the shop the cars are raised with the overhead crane and again placed on car horses. The special car carriers are removed from the trucks and returned by the overhead crane to the eighth position to be reapplied. The rivets are applied to doors, outside and inside hopper reinforcements, and bottom angles, and any defective rivets previously applied are replaced. Couplers, draft gears and brake-shaft fixtures are applied and all work pertaining to the air brakes is performed. Any necessary welding in the body of the car to eliminate the loss of lading particularly slack coal is performed in this position. After the repairs have been completed the cars receive a final inspection before painting and any work improperly performed is corrected.

After the repairs have been completed the cars are moved to the outside of the shop where they receive the first coat of paint, after which they are moved to the paint track for the second coat and stencilling.

New and Modern Air-Brake Department

For the past several months considerable study has been given to the cleaning and repairing of triple valves on a production basis. One of the illustrations shows the arrangement of the air-brake room developed to accomplish this purpose. The triple valves as they are



Triple valve repair department is well laid out and equipped

received for repairs are placed in a special bin provided for that purpose. The first operation consists of completely dismantling the valve and the cleaning and gaging of the triple-valve body. As the parts are removed from the triple valve they are placed on an endless belt which travels the entire length of the bench and is driven at a speed in direct proportion of the valves required per day, the power being furnished by an electric motor. The use of a belt for conveying the triple-valve parts from one position to another eliminates the possibility of damaging the external parts of the valve details. In the second position all parts of the triple valve are cleaned and gaged, except the body, which received attention in the first position. The cleaning and polishing of the internal parts of the triple valve is facilitated by special rotating brushes and the grinding of the check valve is effected by a special power-driven device. All parts which fail to pass the prescribed gages or are found otherwise defective are replaced by O. K. material taken from the material bins directly in front of the workmen. The parts are so placed on the belt in this position that they will be available to the workman in the next position in the order in which they are required for assembling. In the last position the triple valve is lubricated and assembled, after which it is placed on the belt and are conveyed to a special bin directly back of the test rack where the valves are available for final test on 3-T test rack. Any valve which fails to pass the test is returned to the bench where the necessary repairs are made, after which the valve is re-tested. This method of cleaning and repairing triple valves has resulted in increased production and a substantial saving in labor cost.

No attempt has been made to cover the many details which are essential to the success of the progressive system, only a general outline being given.

Radial Buffer with Friction Compression Resistance

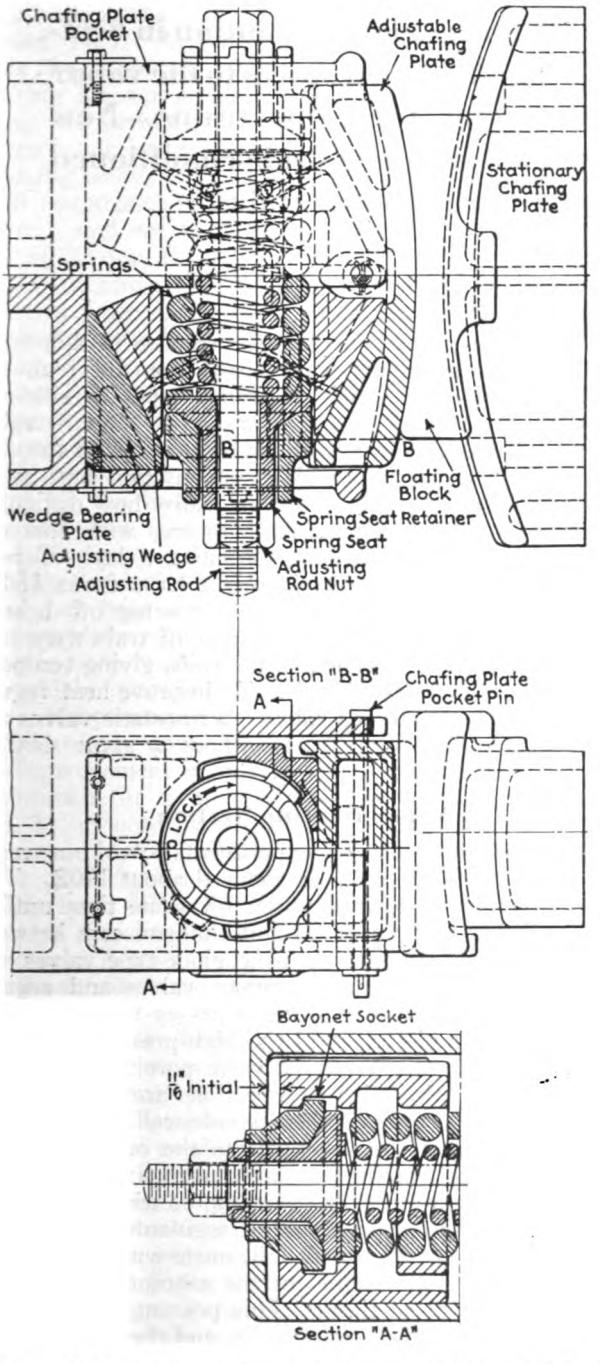
A BUFFER for service between the locomotive and tender is required to permit complete flexibility of movement between the two vehicles in passing through curves and turn-outs, as well as for side movement and rolling of the two vehicles with respect to each other. At the same time the buffer surfaces must always maintain contact. The development of lost motion subjects the drawbar and drawbar connections to destructive shocks.

The Franklin radial type buffer has for many years been the most effective means for accomplishing these ends. In this device the contact between the chafing plates, through the floating block, is maintained either by direct spring compression or by adjustable wedge behind the adjustable chafing plate on the tender. In the Franklin type E-2 radial buffer, which has recently been developed by the Franklin Railway Supply Company, New York, the same principles for universal flexibility of motion between the engine and tender have been employed, but direct spring compression behind the adjustable chafing plate has been replaced with spring-controlled frictional resistance which provides a resistance to compression of four to six times the magnitude of the forces which the unit is capable of transmitting to the drawbar connections. Thus the relatively light force tending to separate the engine and tender reduces the loads causing wear on the drawbars and pins, while interposing a resistance to compression in buffing action which may be as great as the tractive force of the locomotive. This keeps the engine-tender connection tightly laced at all times so that the inertia of the tender becomes a part of the effective inertia of the locomotive in absorbing and damping longitudinal and nosing vibrations.

The illustrations show clearly the principle on which the device is built. The tandem unit of two A. R. A. Class G springs, acting transversely on movable double-taper wedges, exerts the force which keeps the adjustable chafing plate in contact with the stationary chafing plate through the floating block. This arrangement keeps the adjustable chafing plate constantly in proper alinement, preventing cocking which resulted from the failure or weakening of one of the springs in the older arrangement. It also greatly simplifies the coupling and uncoupling of the engine and tender, as well as drawbar inspection and the inspection of the radial buffer itself.

For assembling the wedges, springs and adjustable chafing plate in the buffer pocket the two Class G springs

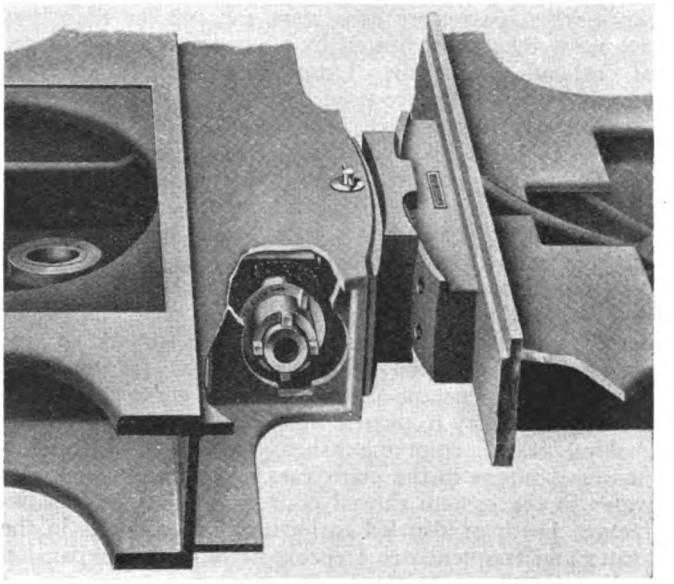
and spring seats are placed on an adjusting rod or bolt and compressed by drawing up the nut on the end of the rod. After the triangular wedge wearing plates have been placed in the back of the buffer pocket and the wedges are inserted, the adjustable chafing plate is then placed in position against the outer faces of the wedges



Plan and elevation sections of the type E-2 radial buffer

and secured in the pocket by a pin and cotter. This passes through a slot in the chafing plate which permits the latter to adjust itself freely in service. The spring and spring-seat assembly is then slipped through the side of the pocket and into the central passages in the wedges. A spring-seat retainer is next slipped over the end of the spring seat and turned to the right, causing lugs on the retainer to lock in bayonet sockets in the wedge. A similar operation at the other end of the springs completes the assembly. The removal of the nut from the adjusting rod releases the spring pressure, causing the spring seats to bear against the spring-seat retainers and thus against the wedges which tend to force the adjustable chafing plate outward.

In connecting and disconnecting the locomotive and tender the use of the adjusting rod and nut to release the wedges from the spring pressure makes it unnecessary to use another locomotive to relieve the drawbar of the buffer load and release the drawbar pins. In the



The Franklin type E-2 radial buffer

same manner the spring assembly may be removed from the buffer pocket and the wedges inspected without uncoupling the drawbar.

The friction surfaces between the adjustable chafing plate, the wedges and the wedge bearing plates are so proportioned in area and angle as to reduce wear to a minimum. When wear accumulates, however, the release of the spring pressure against the wedges by the use of the adjusting rod and nut permits the insertion of shims behind the wedge bearing plates at the rear of the buffer pocket without the removal of any of the parts. The wedge bearing plates are simply moved forward and the shims inserted behind them through slots in the ends of the buffer pocket.

The E-2 type radial buffer is applicable to existing locomotives as well as to new power. For existing locomotives a separate buffer pocket is provided which can be bolted or welded to the tender frame. In the case of new power it forms an integral part of the tender-frame casting.

RAILROAD HISTORICAL EXHIBIT.—An exhibition of historical railroad pictures and models is now in progress in the east balcony of the Grand Central terminal in New York. Sponsored by the Railway & Locomotive Historical Society, the exhibition will continue through April. The society itself makes an interesting story It is the first organization in America to devote itself to the collection, preservation and exhibition of all kinds of historical railroad material. Incorporated in 1921, with headquarters in the Baker Library, Harvard Business School, it has enjoyed steadily increasing prestige and membership. A growing collection of material is on public exhibition in the museum at the society's headquarters. Local chapters have been organized in some of the larger cities and the New York chapter, at the request of the New York Central, has loaned material and assisted in the preparation of the exhibition now in progress.

Developments in Heating Passenger-Train Cars*

By W. H. Tucker†

Outline of the evolution in heating from coal stoves to the vapor system for long trains—New problems met in air-conditioned and rail-motor trains

CAR heating, like most other features of railroad development, has undergone many changes. In early days, when passenger cars were far smaller than they are now, they were heated by an ordinary stove placed at one end of the car. Later on, as cars increased in length, two stoves were used, one at each end of the car. Today, with the modern health and safety precautions offered by the railroads, one can hardly realize the difficulties which were experienced in forcing fires on extremely cold days, the dirt from the coal and ash dust, to say nothing of the fumes from gases, another dangerous fire hazard that once existed.

A realization that better heat distribution was necessary led to the development in 1863 of Baker hot-water heaters with side-wall coils for radiation surface. Brine was used as a partial protection against freezing, but cars required constant attention both in service and during layover. Try to picture men in railroad yards today shaking grates, emptying ashes, applying coal and adjusting dampers in the many cars now in service? Low water in the system caused poor circulation or unsatisfactory heating; also led to burning out of coils in the heater and frequently to freezing of radiation, expansion tanks and other parts.

Steam Heating Adopted

About 1886 or 1887 there was a serious collision in a railroad tunnel approaching New York city. The overturning of heaters set fire to the wooden cars and passengers were killed and injured on this account. This led to the adoption of steam, which at that time was already in use on the New York Elevated lines.

As should be expected, it required a great deal of time and expense to equip yards and terminals for steam supply. Railroads and private car owners, particularly the Pullman Company, knew that something would have to be done to retain the hot-water system until adequate provisions were made for steam supply both in service and at terminating points. Steam jackets—consisting of a pipe within a pipe—were applied under the cars, steam from a train line being passed through the jackets to steam traps at low points in the pipe line. Water pipes from the heating coils inside the car were connected to the jackets under the car. The water did not mingle with steam but passed through a pipe surrounded by steam, thereby being heated through conduction.

When cars with this arrangement arrived at a terminal where steam was not available a fire could be started in the heater. Moreover, if there happened to be a steam supply failure while cars were in service, they could still be heated by starting fires in the heaters.

Duplex or double coils were offered as a substitute for steam jackets. These coils were placed inside of the heater, being constantly in use during the heating season, either with steam passing through the inside coil or fire in the heater combustion chamber around the outside coil—the one containing water.

The Pullman Company and some railroads installed "straight steam" heat during the year 1891 and it was used extensively in following years—in fact it is still used today on one of the largest railroads in this country. With this system, steam passes from the train line through globe type valves in branch pipes to side-wall coils inside the car. Steam traps and blow-off valves are placed under the car, with connections from the coils inside the car, through which condensation and steam pass to the lowest point. You can realize how difficult it would be to maintain even temperatures with this system, particularly in long trains running today. Cars at the forward end of the train might have from 150 to 170 lb. pressure in heating coils throwing off heat at 366 to 375 deg. F., while cars at rear of train may have from zero to 10 lb. pressure in the coils, giving temperatures from 212 to 240 deg. F. To improve heat regulation, all sorts of reducing valves, thermostatic valves and modulated valves were tried without a great deal of success.

Vapor Heating System

After several years of experimental work, a vapor system of car heating was introduced about 1902. This system received little recognition for some time until it was applied to many railroad and Pullman cars between 1905 and 1908. Instead of using globe-type valves and steam traps, short-circuiting cutout valves and regulators were applied to cars. Steam passes from the train line through branch pipes to the high-pressure chamber of a regulator, then through a valve port to a low-pressure chamber. From here connections are made to cut-out valves inside the car, then to side-wall heating coils. Condensation and steam returns to the outlet chamber of the regulator, coming in contact with a metal expansion diaphragm in the bottom casing, or what is at times referred to as the trap portion of regulator. The hinge cover or bottom of the regulaor is made with large openings, giving an open outlet at the extreme end of the heating system at all times. This prevents the building up of pressure in the heating coils, and the constant expansion and contraction of the diaphragm opens and closes a valve in the regulator under the car, maintaining an atmospheric or vapor supply of steam at 212 deg. F. in all heating pipes, regardless of the position of car in the train or the amount of steam pressure in train line.

Other systems were introduced such as Unotherm, Thermo-Jet, combined pressure and vapor. They were applied to many cars but have been gradually removed as the length of trains and steam pressures have increased.

There are at times controversies between the railroads and Pullman Company on contract matters. Following a thorough investigation made about 1916 or 1917, meet-

*A paper presented at the February, 1934, meeting of the Eastern Car Foreman's Association.

†Eastern manager, Vapor Car Heating Company, Inc.

ings were held between railroad and Pullman officials of a certain trunk line and car heating received considerable consideration. This brought out the fact that there was not only a heavy steam loss while cars were standing in yards with supply valves open, but also showed that inside finish was being damaged by excessive heat.

Thermostatic Control

Thermostatic control was successfully introduced about 1921. At that time the most important feature was the automatic selection of a low-degree temperature during layover period. This was accomplished by tapping the air brake line and running a branch pipe to an electric air-selector switch inside the car. When air is missing or out of train line, the air portion of this switch will automatically change the electrical position of the switch and cut in the low-degree thermostat, generally set at 50 deg. F.

To determine the real value of this yard or layover control feature, tests were conducted in a railroad yard facing a lake front, when the outside temperature was 6 deg. F. above zero. The magnetic steam cut-out valves under the control of the 50-deg. thermostat were in the "open" position, admitting steam to heating coils inside of car, 23 per cent of the 24 hours. Under manual control the same valves would have been "open" 100 per cent of the time. Consider what this means in coal consumption. To maintain car temperatures between 70 and 80 deg. at a layover point (and they are frequently 90 deg. or higher) it requires between 12 and 15 lb. of coal per hour per car, whereas to maintain a 50 deg. temperature requires but 5 lb. of coal per hour per car. It was soon realized that the train service control feature should be extended and thermostats were made to regulate temperatures for either mild or extremely cold days and are now in service in thousands of cars.

Improvement in motive power brought about the development of locomotives capable of hauling trains of 18, 20 or more passenger cars. Railroads soon realized that one of the problems would be getting steam to the rear of such trains.

Early in 1927, the New York Central conducted extensive standing tests at West Albany, also road tests between Albany and Utica. Twenty coaches and 20 Pullman cars were used. All cars had 2-in. steam train line with 1½-in. end train-pipe valves, rubber hose and 1½-in. coupler heads. Hose were removed and 1½-in. metallic joints substituted so that higher pressures could be forced through the train lines. With the test gage in the locomotive cab showing between 175 and 183 lb. on a road test between Utica and Albany, it was found that the rear car of the 15-car all-Pullman train could not be properly heated. This convinced both Pullman and railroad engineers that 2-in. end valves, 2-in. metallic joints and 2-in. coupler heads would have to be applied, and at the present time there is an A. R. A. rule covering this change.

Heating Problems with Air Conditioning

The introduction of air conditioning brought out new factors that have to be considered in car heating. In air-conditioned cars the ventilating systems used in the past are in some cases retained for winter use only. Realizing the advantage of keeping deck sash and exhaust ventilators closed the entire year, and ventilating cars through the air-conditioning units, railroads and air-conditioning companies arranged for the application of small fin-type heating radiators in air-conditioning units. Blower fans drive both the fresh air from outside intake and the recirculated air through heating radiators. Instead of heating from direct radiation on the side walls of the car, heating is now through convection from overhead air-conditioning units and radiation from side wall or floor coils. It must be remembered that side wall or floor coils are absolutely necessary for proper heating in train service, also for layovers.

The changes in temperature for both cooling and heating through convection are decidedly more rapid than through direct radiation. Thermostatic control devices had to be developed for proper regulation and are in use today or being applied to nearly 1,000 cars.

To properly regulate heat in an air-conditioned car, sidewall radiation and overhead radiators in air-conditioning units should be under the control of separate thermostats. Control panels are available with necessary relays, reclosing circuit breakers, fan and seasonal switches, also fuse blocks and fan-speed resistance units, when fans with more than one speed are used. The seasonal selector switch can be operated for the desired temperature for either cooling or heating. For this selection a thermostat is placed in the circuit that actuates the relay, cutting in or out the pump and compressor or the magnetic steam-supply valve, depending entirely on control required to bring about a comfortable condition inside the car.

Controls are arranged so that it is impossible to have heat supply to overhead radiators when cooling is desired, or in other words the selection of a cooling circuit locks out the heating circuit and vice versa. Other features of control include a positive "off" setting for the magnetic steam-supply valves to overhead units when the blower fan switch is off during layover at any terminating point. This eliminates steam waste and overheating of electrical devices in the air-conditioning unit.

Heating Rail Motor Cars

Before considering the heating of light-weight, high-speed rail motor cars, it should be remembered that in the few short years that motor-driven cars have been in railroad service, drastic changes have been made in car design and engine horsepower. With each change it was found that heating was one of the many problems.

In 1922 a small demonstrating car was built in which a Baker hot-water heater with side-wall pipe coils was installed. About 1924 the New York, New Haven & Hartford placed a number of small cars equipped with hot-air heaters in service. Metal ducts were built along the side wall and floor line and the heated air was forced through the ducts by blower fans.

Realizing that rail motor service held greater possibilities, larger and more powerful cars were designed. Some of these cars consisted of engine room, mail, baggage and passenger compartments, with each compartment requiring heat supply under independent control. Improved hot-water heaters, having greater capacity had to be developed to handle split circulation in many independent coils. To increase the heating efficiency fin radiation was substituted for standard pipe. Advantages of fin radiation over standard pipe for such installations are: less space, reduction in weight, decrease in amount of water to be handled through heater, bringing about faster circulation and thereby increasing heating efficiency. This radiation is desirable in any type of railroad equipment, but should be under thermostatic control in steam service on account of the rapid temperature changes.

The next development in rail motor service covered cars with sufficient engine power to haul trailers. At first cars much lighter and smaller than standard steam rail equipment were built for this purpose, both the rail motor and trailer cars being equipped with hot-water

heaters. As this type of trailer car could be used only with rail motor cars and as numerous cars for steam rail service were in storage the continued purchase of such trailer equipment seemed inadvisable.

Car heating companies were now confronted with the problem of furnishing steam for rail motor service. Vertical-type steam boilers were in use in electric locomotives but they were entirely too large and heavy for this service. High-pressure boilers were designed to suit every service condition. They had to be made to A. S. M. E., I. C. C. and P. S. specifications, and so added considerable weight to rail motor cars.

Complete automatic controls were necessary for this service. Oil burners and water pumps were actuated by pressurestats, water-level and low-water controls. Between boiler and steam train line under the car, a main supply line pressure reducing valve was installed. Experience has proved that safety features and design of boiler make impossible accidents due to low water or any control feature.

With the advent of light-weight, high-speed rail motor trains, everything possible had to be done to reduce weight. As high-pressure steam boilers and large water-storage tanks could not be considered on account of weight, it became necessary to develop a low-pressure boiler, working under 15-lb. pressure, which did not have to be made to standard high-pressure boiler specifications. All controls are automatic and water-storage capacity has been greatly reduced by the return of condensation through traps on the ends of the heater coils.

A light-weight, high-speed, streamlined train recently placed in service is heated through hot air convection from radiators used in conjunction with the engine cooling system and automatic oil-burning hot-air generating units. Floor ducts, with necessary outlet restrictions for proper heat distribution are on both sides of the cars. The ceiling duct, through which cool air enters the car in the summer season, serves as an exhaust or recirculating duct during the heating season. This circulation is regulated through automatic dampers.

Heated air from the engine radiator is forced by blowers through ducts in the cars with flexible bellows as conductors between the cars. If sufficient heat is not delivered by the engine radiator to properly heat the cars at all times, a fire is started automatically by electric ignition in the oil-burning hot-air generating units—one on each side of the baggage compartment in the motor car. These units are also used for heating the cars in stations or yards while the engine is idle. The units are simple in design, compact and have a high radiating efficiency. They burn the same grade of distillate as is used to run the power unit; all controls are entirely automatic.

Another train development in light-weight, high-speed, streamlined design, still in the course of construction, will be heated with steam furnished by a high-pressure boiler with all the latest improvements in complete automatic control and safety. Condensation from all radiators, both in air conditioning units and side-wall coils, will be returned to a small water-storage tank under the floor of the car in which the boiler is located, by means of an entirely new automatic arrangement.

The Friction of Railway Brake Shoes*

An investigation made at Engineering Experiment Station, University of Illinois, to determine variations in friction with speed and shoe pressure on chilled iron and steel wheels

THIS investigation was undertaken in order to determine the tangential pull and the coefficient of friction produced by two kinds of brake shoes on both chilled-iron wheels and steel wheels, and to find the variations of the pull and the coefficient with speed, with pressure and with duration of application, and also their difference on the two kinds of wheels.

The shoes used were Diamond S shoes and Special Chilled shoes, the former being a cast-iron shoe with an embedded steel mesh, the latter a plain cast-iron shoe. Both types had chilled ends. The tests were made on four wheels—two chilled-iron wheels, one of which was new and the other partly worn, and two steel wheels, one new and one partly worn.

Three kinds of tests were made during the investigation; namely, Series 1, stop tests; Series 2, constant-speed tests; Series 3, 15-min. constant speed tests. In the stop tests the shoe was applied when the wheel in the testing machine had attained the desired speed, and the wheel and the attached rotating parts of the machine were brought to rest under the action of the shoe. Five such stops under identical conditions of pressure and speed constituted one test, and the series comprises 169 tests, or 845 stops. These tests simulate the conditions under which a train is brought to rest by the application of the brakes.

In the constant-speed tests the wheel of the testing machine was kept running at uniform speed by means of the testing machine engine, while the shoe was alternately applied and released, the duration of the application being 190 revolutions of the wheel (1,642 ft. travel), and of the release period 610 revolutions (5,270 ft. travel). Ten such applications constituted one test, and the series comprises 202 tests. These test conditions simulate those which prevail in bringing a train down a long grade.

The third series, the 15-min. tests, was a modification of the second. In them the shoe was continuously applied to the wheel for 15 min., the wheel being driven at uniform speed and no attempt was made to cool either the

* Abstracted from Bulletin 257 of the Engineering Experiment Station of the University of Illinois, describing tests made by Edward C. Schmidt and Herman J. Schrader in co-operation with the Association of Manufacturers of Chilled Car Wheels.

shoe or the wheel. One such application constituted a test, and the series includes 28 tests, each made under a different combination of wheel, pressure and speed. These tests were made on used chilled iron and steel test wheels only.

In the three series the range in speed and in pressure was as follows:

	Range in speed, m.p.h.	Range in pressure, lb.
Stop tests	20 to 60	2,250 to 4,500
Constant-speed tests ...	20 to 40	500 to 4,000
15-min. tests	20 to 40	1,500 to 2,500

Since the general trends in the variation of the co-efficient of friction with speed, pressure, kind of shoe

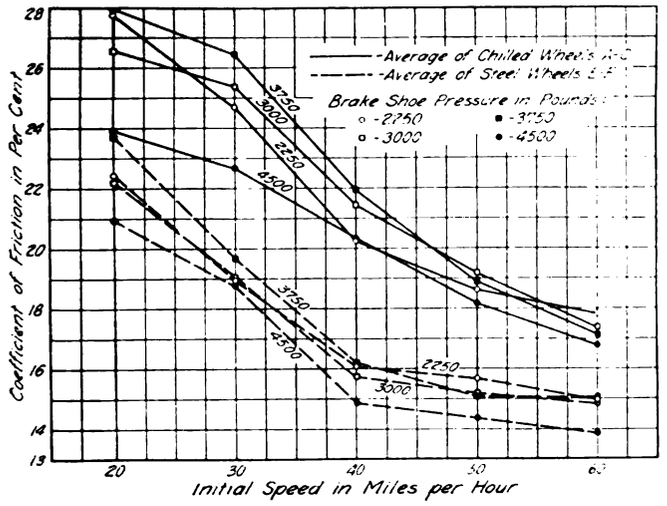


Fig. 1—Relation between coefficient of friction and speed —Stop tests—Diamond S shoes on chilled and steel wheels

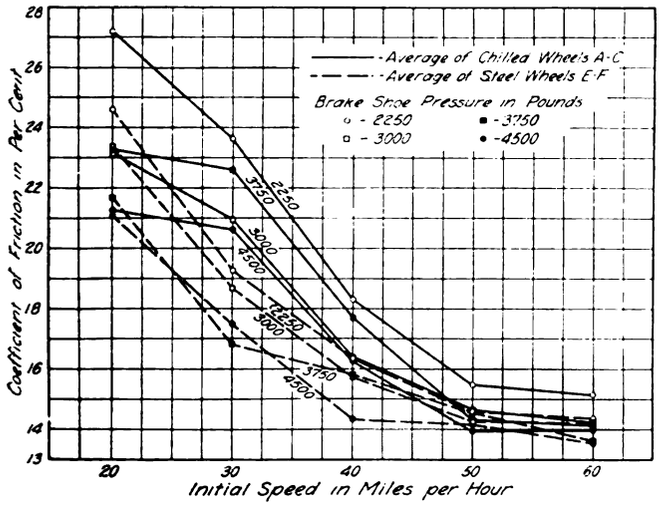


Fig. 2—Relation between coefficient of friction and speed —Stop tests—Special chilled shoes on chilled and steel wheels

and the like are similar in the stop tests and in the constant-speed tests, the results of these two series are stated together first. The results of the 15-min. tests are stated afterward.

Variation of Co-efficient of Friction with Speed.—In both the stop tests and the constant speed tests there was a marked decrease in coefficient of friction and in tangential pull as the wheel speed was increased under any given test pressure. This is true of the results produced by both kinds of shoes on all four wheels.

Variation of Coefficient of Friction with Shoe Pressure.—In both the series the pull and the coefficient decline, in general, as the shoe pressure is increased. In the stop tests the decline is somewhat irregular and less in amount than in the constant-speed tests. In the latter the decline is not only greater, but it also occurs almost invariably with both kinds of shoes and all four wheels. In the constant-speed tests the coefficient at 2,000 lb. shoe pressure was only about two-thirds as great as at 500-lb. pressure.

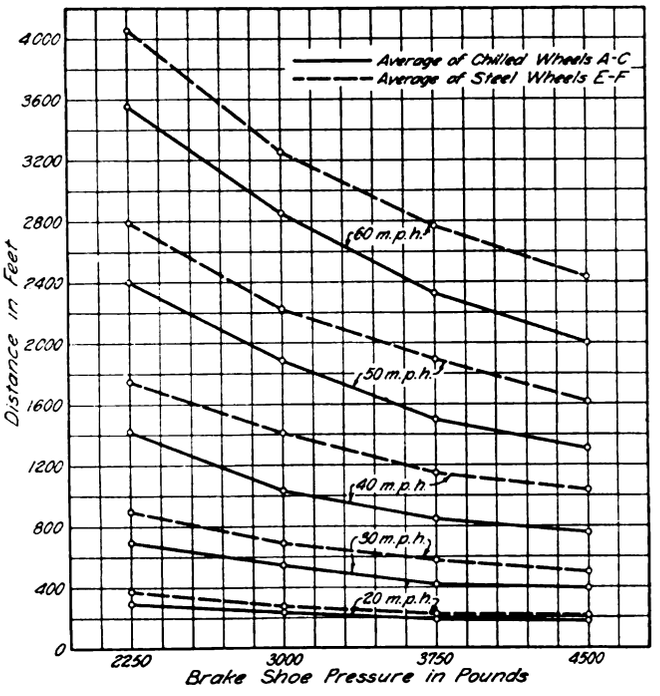


Fig. 3—Relation between stopping distance and brake shoe pressure—Stop tests—Diamond S shoes on chilled and steel wheels

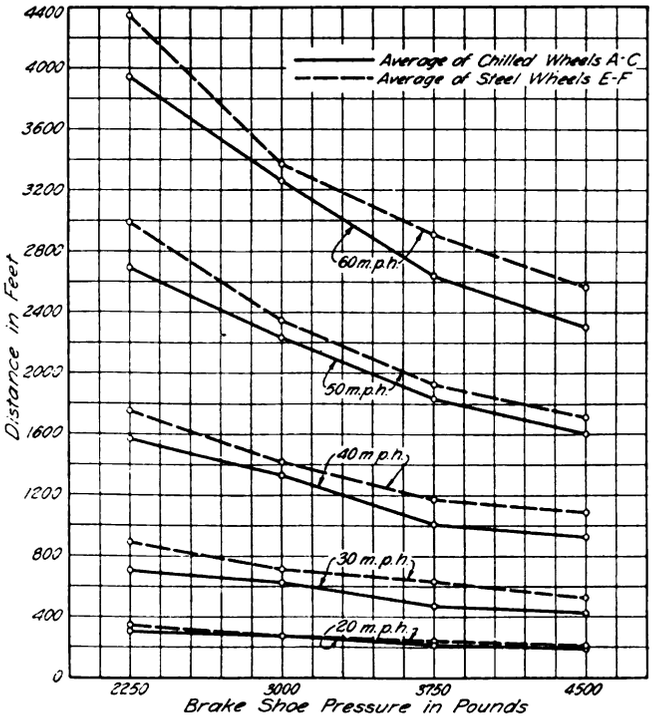


Fig. 4—Relation between stopping distance and brake shoe pressure—Stop tests—Special chilled shoes on chilled and steel wheels

Difference in Performance of Diamond S and Special Chilled Shoes.—In both the stop tests and the constant

speed tests the coefficient of friction produced by Diamond S shoes is greater than that produced by Special Chilled shoes under the same conditions of shoe pressure, speed and kind of wheel, and whatever is said of the coefficient is, of course, equally true of the tangential pull.

In the stop tests among 40 pairs of comparable average values of the coefficient there are only five pairs in which the coefficient produced by the Diamond S shoes is not greater than that produced by Special Chilled shoes, and in the constant-speed tests there is only one such exception among 30 pairs of comparable values. The excess with Diamond S shoes is frequently of notable amount, running as high as 32 per cent in the stop tests and 38 per cent in the constant-speed tests.

Difference in Brake-Shoe Performance on New Wheels and Used Wheels.—Since in Series 1 and Series 2 tests with each kind of shoes were made on each of two new wheels and on each of two used wheels, there are in each series four pairs of combinations of shoe and wheel.

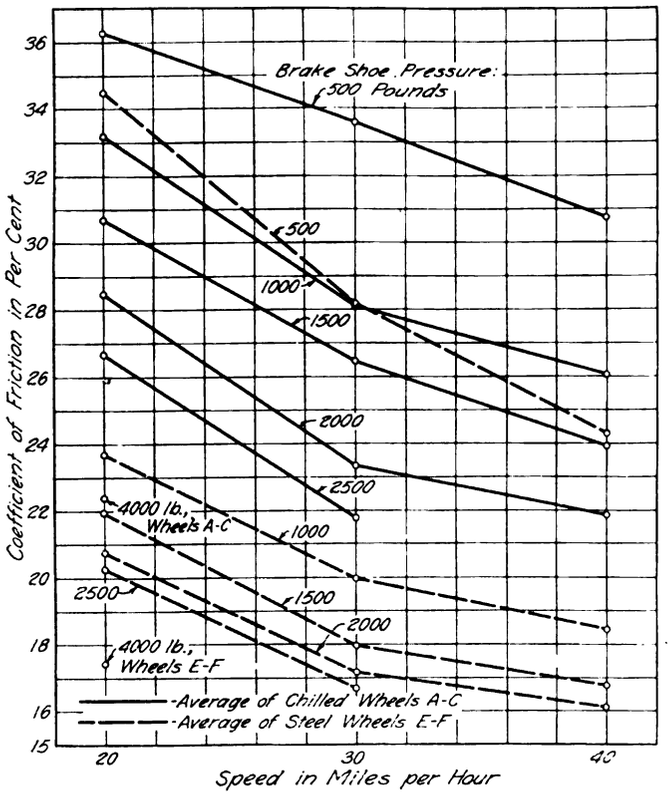


Fig. 5—Relation between coefficient of friction and speed —Constant speed tests—Diamond S brake shoes on chilled and steel wheels

In each of these pairs the only difference is that the tests in one instance were made on a new wheel and, in the other, on a used wheel.

In the stop tests in one of these pairs (Diamond S shoes on chilled wheels) the greater coefficient was produced on the new wheel, the excess over that on the used wheel being 11.2 per cent. In the three other pairs the excess occurs in tests made on the used wheels, and it ranges from 6.5 to 15.5 per cent.

In the four corresponding pairs of general average values of the coefficient produced in the constant-speed tests, the coefficient is, without exception, greater on the new wheels, the excess ranging in amount from 0.1 to 11.8 per cent. These comparisons, in both series, rest upon general average values at all speeds and all pressures. When we deal with comparable values derived under particular combinations of pressure and speed, there are exceptions to the general tendencies which have just been cited.

Difference in Brake-Shoe Performance on Chilled Wheels and Steel Wheels.—The results of both stop tests and constant-speed tests disclose a notable difference in performance on the two kinds of wheels. With exceptions so infrequent as to be practically negligible, both the coefficient of friction and the tangential pull are greater on chilled wheels than on steel wheels under identical conditions of shoe pressure and speed, with both kinds of shoes.

Dealing with average values of coefficient and pull on new and used wheels of like kind, there are in the results of the stop tests 40 pairs of comparable values of these two quantities. Among these 40 pairs there are only three in which the coefficient and pull are not greater on chilled wheels than on steel wheels, and in these three exceptions the general tendency is just barely reversed, the excesses on the steel wheels being respectively only 1.0, 1.5 and 2.0 per cent, whereas in the remaining 37 pairs of values the excess on the chilled wheels ranges from 0.1 to as much as 36.5 per cent. For the entire stop-test series the general average excess on chilled wheels is 16.7 per cent.

The results of the constant-speed tests likewise exhibit a marked superiority of coefficient and pull obtained on chilled wheels, and in this series not only is the excess somewhat greater than in the stop tests, but there are

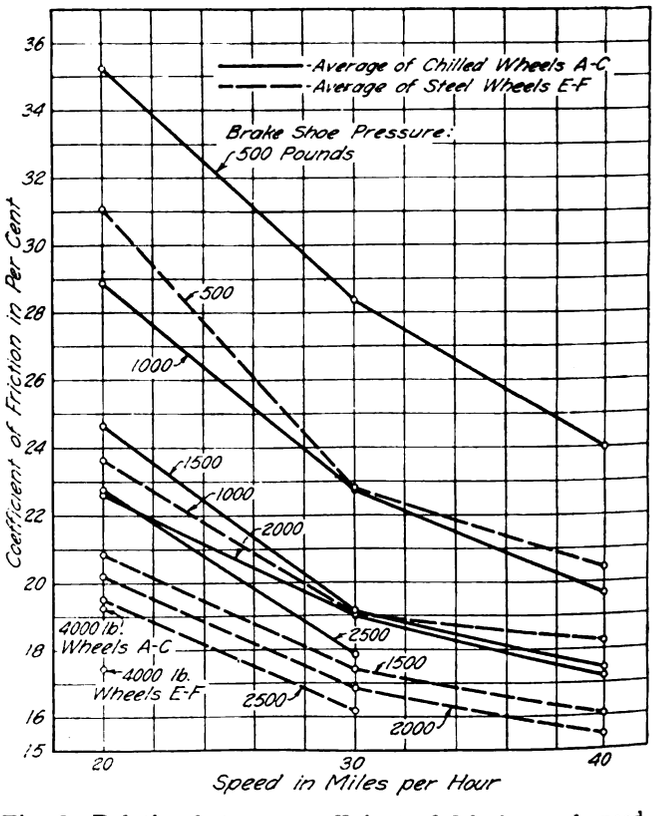


Fig. 6—Relation between coefficient of friction and speed —Constant speed tests—Special chilled shoes on chilled and steel wheels

also no exceptions whatever to the general tendency. The coefficient and pull are greater on the chilled than on the steel wheels, whether we deal with the results produced by Diamond S shoes or Special Chilled shoes, on either new wheels or used wheels. The excess ranges from 5.1 per cent to as much as 47.3 per cent. Comparing the general average values of pull and coefficient

produced during 100 constant-speed tests on chilled wheels with the corresponding average values produced in 102 tests on steel wheels, the average excess on the chilled wheels is 23.5 per cent.

Results of 15-Min. Constant-Speed Tests.—These tests were undertaken in order to try to check the validity of an opinion long prevalent among railroad men; namely, that in long-continued brake-shoe applications there is a general breakdown in the coefficient of friction. These 15-min. tests were made under some of the combinations of pressure and speed used in the constant-speed tests of the second series, and their results are directly comparable with the corresponding results of that series. The duration of the 15-min. tests was from 16 to 33 times as great as the duration of the individual applications of the constant-speed tests.

The results of these tests lend no support to the opinion just cited; they not only disclose no breakdown in the value of the coefficient of friction, but also in 24 of the 28 long-continued tests the average coefficient was greater than in the constant-speed tests run under identical pressures and speeds—by amounts which vary from 0.7 to 37.4 per cent.

Brake-Shoe Wear.—The wear of the brake shoes during the constant-speed and the 15-min. tests was determined by weighing and the loss divided by the foot-pounds of work done in order to make the results comparable. The wear thus obtained is shown in the accompanying table.

BRAKE-SHOE WEAR IN CONSTANT-SPEED TESTS AND IN 15-MIN. TESTS

Wheel	Kind of shoes	Lb. Wear per 100 Million Foot-Pounds of Work: Constant-speed tests	15-Min. tests
Chilled	Diamond S	0.346	0.396
	Special Chilled	0.497	0.649
Steel	Diamond S	0.530	0.327
	Special Chilled	0.583	0.642

It will be noted that, in general, the rate of wear is greater under the long-continued applications. This supports the inference that the increase in coefficient of friction in the 15-min. tests is caused by a softening of the brake-shoe material.

Draft Gear, Cinders, And Some Other Things*

What mechanical department can do to guard against the loss and damage to property

WHEN I talked with the Freight Loss and Damage Expert, as reported on page 425 of the December, 1933, number of the *Railway Mechanical Engineer,* he suggested that I interview a certain officer in charge of policing a railroad, for comments on how the mechanical department could be helpful in reducing the amount of loss and damage due to theft and robbery. I followed up this tip, and while it did not produce much constructive material on this particular topic, it did bring out some excellent suggestions on the broader problem of loss and damage to freight.

Theft and Robbery

"What can the mechanical department do to assist in reducing the losses from theft and robbery?" I asked.

"Not a great deal," replied the railway officer, "other than to maintain the physical condition of the cars to the highest possible standard. As a matter of fact, the losses from the cars by theft is not such a large item, particularly if we except pilferages of coal and coke, for which the mechanical department is in no wise responsible. Roughly speaking, from one-half to two-thirds of the losses due to theft occur in transit. Usually entrance to the car is gained by breaking the seal. The mechanical department is not involved in these operations, but it is concerned in such losses when freight can be removed by manipulation of door guides or fastenings, or because of defective condition of the equipment.

"If for the year 1933, for instance, we take those losses due to robbery of entire packages, or other than entire packages; add to it the concealed loss; subtract from this the losses of coal and coke by robbery; and then, to be generous in our calculations, go a step further and add one-half of all the losses of entire packages and other than entire packages, the figure will amount to approximately one million dollars. Assuming that one-half of these losses occur while the lading is in the car, the total for all of the railroads will be only a little over $500,000.

"Could the mechanical department do anything which would help to still further reduce this figure, even though it is comparatively small?" I asked.

"That department has already gone a long way in making theft and robbery from the cars difficult, by improving the door fastenings and otherwise strengthening the construction of the car, so that when properly maintained it is not an easy task to gain access to and remove the lading without breaking the seals. It is true that certain additional devices, not now used, have been developed which make it more difficult to break into the car, but these cost much more to install and operate than could possibly be saved by their use under present conditions.

"There is one place," continued the railway officer, "which must be carefully watched from a maintenance standpoint, and that is the ice bunkers on refrigerator cars. Hoboes occasionally get into these bunkers, break through the screen and remove lading from the car. This is particularly true where the screens are not sufficiently heavy and are not properly applied and maintained. An additional safeguard may be used in the form of cross rods, so applied that they cannot be removed from the inside of the bunkers."

Cinders

Realizing that we were not getting very far from the standpoint of theft. I shifted my attack to a more general one by inquiring about important factors within the control of the mechanical department that were responsible for damage to property.

"While I believe that the danger is greatly over-rated,"

* Ninth of a series of interviews with men outside the mechanical department, commenting in a constructive way upon the possibilities of that department.

replied the railway officer, "everything possible should be done to reduce the amount of cinders discharged from locomotive stacks. There is a bad psychological reaction when people along the right-of-way are showered with dead cinders, even though they are of small size, and this reaction is even more pronounced when live cinders can be seen issuing from the stacks at night, even though they may be entirely harmless.

"Aside from this, however, the cinders do considerable damage to some types of lading, when they get into box and refrigerator cars. To prevent their entering these cars the doors should be so designed and maintained that they will be close fitting. It is important, also, that they fit snugly at the bottom, so that snow and dirt cannot be sucked up into the car and settle on the lading. We used to have trouble from the cinders gradually working in through the roof, but modern types of all-steel roofs have obviated this difficulty. The damage done by cinders to some classes of lading, however, is so great that no effort should be spared to maintain the cars cinder-proof."

Draft Gear

"Do you have much damage to the lading from abnormal shocks?" I asked.

"Yes, but we have been successful in reducing it considerably," replied the railway officer. "The use of impact registers in the cars has enabled us to check up and locate where these shocks take place. In not a few instances we have found that they were due to improperly maintained draft gear. I cannot too strongly emphasize to the mechanical department officers the importance of periodically checking up on the condition of the draft gear and in seeing that it is maintained in a proper operating condition."

Stock Cars

"Your road handles a large amount of stock. Can the mechanical department do anything to improve the design and maintenance of these cars?"

"Yes," replied the railway officer. "In the first place, there is a possibility of damage if there is too much of an opening near the floor, in which the animals' feet can be caught. For this reason we recommend that the first side board should be placed flush with the floor and that the second one should be placed not much over three inches above the first. Then, too, it is advisable, in our opinion, to have plenty of openings near the roof, so that the heated air may escape. Obviously sharp corners or projections should be entirely eliminated inside of the car. Door posts, for instance, should be made as round and smooth as possible, and door hasps should be properly located. While these details may appear to be unimportant, taken as a whole they mean much in reducing loss and damage to the stock.

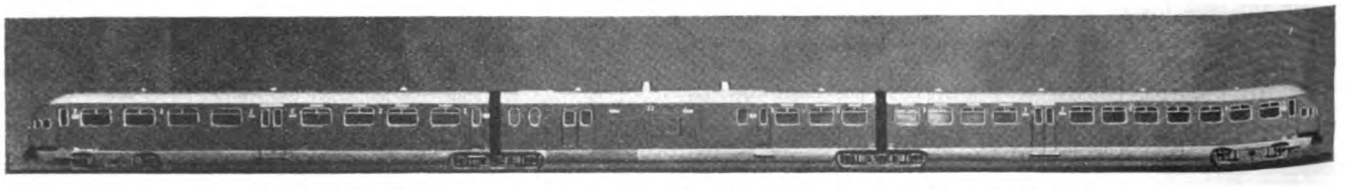
"Summing up," continued the railway officer, "the mechanical department has given us excellent co-operation. The latest equipment has been excellently designed to protect against loss and damage to the lading. The biggest problem is with the older equipment, which does not include the latest and most up-to-date construction and devices, and this is particularly noticeable if it is not maintained to a high standard."

Forty Diesel-Electric Trains For the Netherlands Railways

Holland decides to use three-car, articulated, light-weight, unit passenger trains. Propelled by two 410-hp. Diesel-electric motors and streamlined for high speeds

INFLUENCED probably by the popular success of the famous German streamlined high-speed train, the "Flying Hamburger," which operates between Hamburg and Berlin, the Netherlands Railways decided to employ somewhat similar trains on an extensive scale. Following this decision orders were placed for 40 train units, each consisting of three articulated cars to be carried on four trucks and propelled by two 410-hp. Diesel-electric motors. Construction of these cars is well under way and it is planned to have some of the first units in operation by May 15, 1934. Each train unit will have a seating capacity for 48 second-class and 112 first-class passengers. It is anticipated that these trains will recover a considerable portion of the passenger traffic which has been lost to highway buses in recent years.

Inasmuch as these trains resemble in general appearance and in a number of details the "Flying Hamburger" train, attention is called to a description of the German train which was given in the *Railway Mechanical Engineer*, May, 1933, page 160. This train consists of a two-car articulated unit with seating capacity for 100 passengers—space being also provided for a small refreshment room and a baggage compartment—and an overall length of 137 ft. 5¾ in. It is propelled by two 405-hp. Maybach Diesel-electric motors, one being mounted on each of the end trucks. Two electric motors are mounted on the center truck, a motor for each axle. The light weight of the train is 163,976 lb., to which should be added about 6,600 lb. of fuel oil and the weight of the passengers. The train was designed for a maxi-



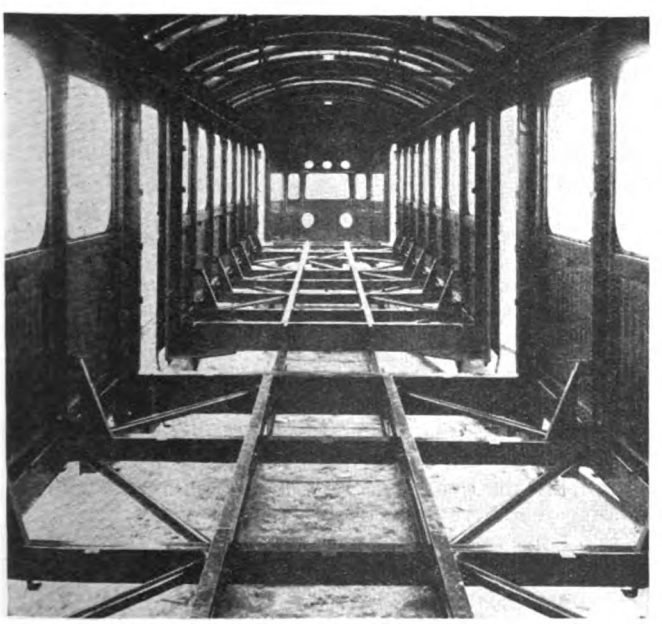
High-speed streamlined Diesel-electric train for Netherlands Railways

mum speed of 99 m.p.h., a regular operating speed of 93 m.p.h., and an average speed of between 75 and 78 m.p.h., on a run of 179 miles.

In comparison with the German train the Dutch trains consist of three-unit sections instead of two-unit sections and are 65 ft. longer, making the total length about 202 ft. 6 in. Despite the increase in length and in carrying capacity there was no increase in weight. This relative reduction in weight was obtained by careful designing; the use of electric welding instead of riveting; the employment of aluminum for many details, such as doors, baggage racks, reservoirs, air ducts and other parts; also the application of pressed-steel wheels and hollow axles. By these means the weight of the new trains was reduced to less than half that of ordinary Dutch passenger cars of equivalent weight and capacity. Lightness of weight, however, was not obtained at a sacrifice of safety. Exceedingly careful study was given to the construction in order to reduce to a minimum any damage that might result from derailment, or from telescoping in event of collision.

The Netherlands Railways have for a number of years made a careful study of electric welding and as a result have brought the process to a high stage of development. Underframes are first erected on jigs and clamped for convenient welding. In building up the body and assembling it on the underframe a squirrel-cage device is employed which is mounted on rollers so that every point of the car becomes easily accessible as the cage is revolved. This device is shown in one of the illustrations. The train being designed for a top speed of 87 m.p.h. has been streamlined as fully as possible comparable with double-end operation.

Of the 40 train units 35 are being equipped with two 410-hp. Maybach Diesel engines and the other five units with two 375-hp. Ganz Diesel motors. The engines are direct coupled to electric generators and are installed in



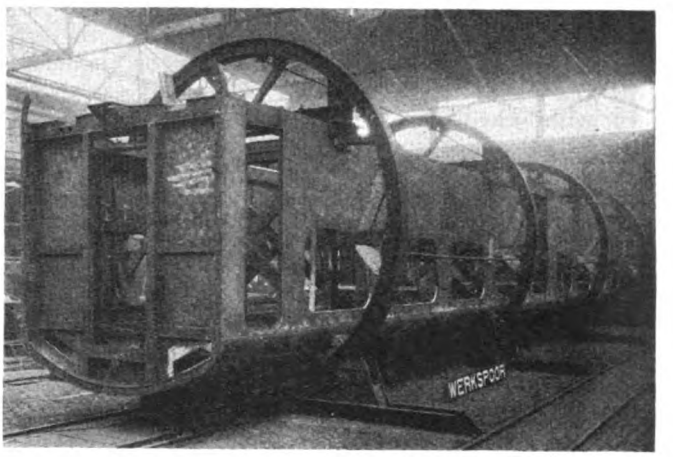
Interior view of a partially completed unit for Netherlands articulated train

the center of the middle unit. Both motors and generators are supported on rubber cushions of four layers each to reduce noise and vibrations.

Brakes are of the automotive type with separate brake drums and ferrodo lined brake shoes. This system was adopted to obtain smoother and shorter stops and to furnish greater safety at high speeds.

The windows are kept closed at all times, ventilation being secured by the introduction of a supply of fresh air at all seasons. In cold weather the incoming fresh air is heated by the cooling water from the engines. Should the cooling water be of too low a temperature to furnish sufficient heat, provision is made to increase its temperature by passing it through an oil-fired heater. The heating system is automatic, both the temperature in the cars and the cooling water being governed by thermostats.

In order to insure regularity of schedules each train unit has been provided not only with a duplicate power plant, but also with duplicate heating and ventilation



Body and underframe assembled in rotating jig for convenient welding

equipment, one or both of which are instantly available as conditions arise. When using only one of the two power plants a train speed of 63 m.p.h. can still be maintained on a level track, sufficient for most schedules.

The nearest similar train now in operation in this country is the three-car, articulated, streamlined train on the Union Pacific. This train is 204 ft. 5 in. long, weighs 170,000 lb. and is driven by a 600-hp. distillate-burning engine. In length and weight the Dutch and the American trains are almost the same; the Dutch train, however, has a greater power capacity.

Duplate Safety Plate Glass

A LAMINATED plate glass, known as Duplate, is being introduced for railroad service by the manufacturers, the Pittsburgh Plate Glass Company, Pittsburgh, Pa. This glass was used for the windows of the Union Pacific light-weight, high-speed train, and is particularly suitable for service of this character because of its shatter-proof or safety feature as well as its tendency to minimize sunlight glare.

As the name implies, Duplate is produced by laminating or sandwiching together two plates of specially prepared ground and polished plate glass.

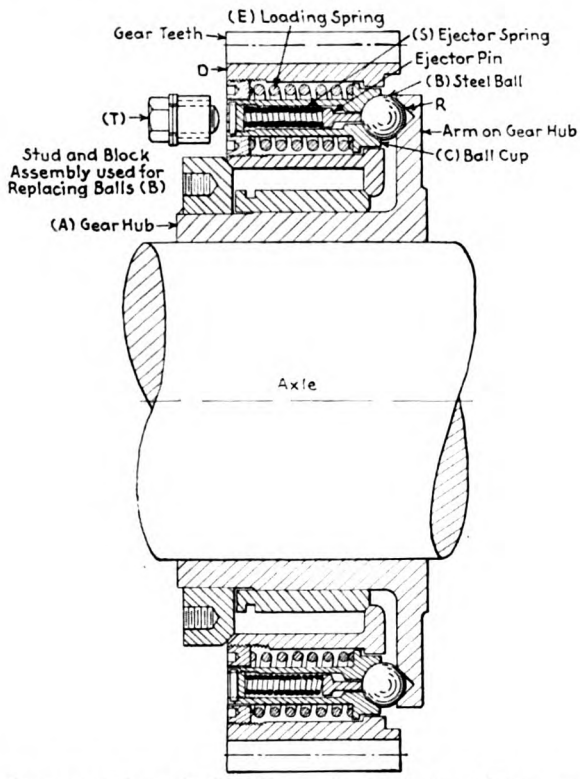
Plastics, from sheets of cellulose nitrate or cellulose acetate, are cemented between companion sheets of glass under a hydrostatic pressure of 190 lb. per sq. in. and a temperature of 250 deg. F. for a definite period of time. The edges are then ground, grooved out to a depth of about $\frac{3}{16}$ in. by removal of the plastic and the groove then filled with a calking compound. Uniformity of product is assured by submitting daily samples to impact test, boil test, baking test and light-transmission test.

Safety Gear for Air-Conditioning Generators

THE use of axle-mounted generators with gear drive for railway passenger car air-conditioning service introduces problems that are not involved with axle-mounted traction motors. The axle-mounted generator is driven by the axle; with the traction motor, the axle is driven by the motor. In the event of mechanical failure of the traction motor, which would prevent rotation of the motor armature, there is no possibility of movement of the car with locked wheels. But in the case of the axle-mounted generator the motive-power for the car is supplied from a source external to the car, and with a "jammed" generator armature, or "jammed" gear and pinion, there is the possibility of car movement with locked wheels, and consequent slid flat wheels. To protect against such contingencies General Electric axle-mounted generators are provided with a "safety" gear, so designed that in the event of the generator armature locking or being excessively overloaded, or if the gears jam, the axle is freed from the gear and continues to rotate without developing flat spots on the wheels.

The sketch shows a cross-sectional view of the safety gear in its normal operating condition.

The gear assembly consists essentially of two main parts—the hub, *A*, which is pressed on the car axle, and

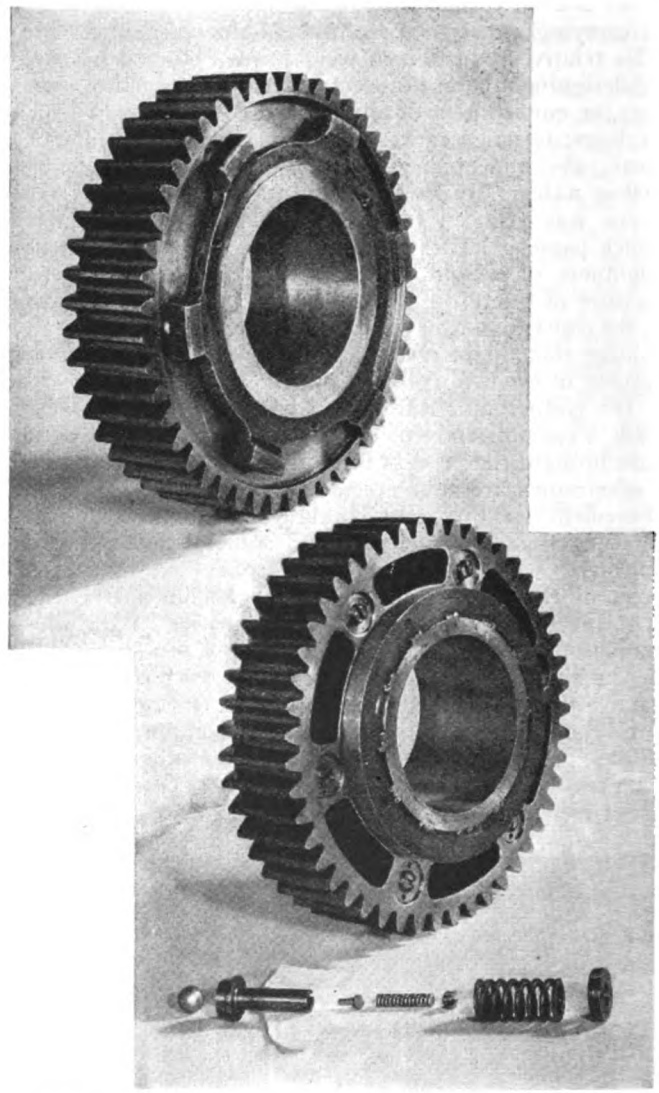


Cross-section of the General Electric safety gear

the gear rim, *D*, which carries the parts that function to release the rim from the hub in the event of emergencies.

There are six ball and spring assemblies located in as many pockets in the rim assembly, and spaced equidistantly around the center. Under normal operating conditions the balls, *B*, are held against and in the sockets, *R*, machined in the arms of the hub. The characteristics of the spring, *E*, and the design of the sockets and balls are such that the unit will not shear because of any coupling shock load which the car structure can stand but will separate if the slipping point of the wheels is approached, such as would occur with a locked armature.

In the event of a mechanical failure in the generator or its gearing, tending to prevent rotation of the car wheels, the shearing effect of the hub arms on the balls forces the balls in against the springs, *E*, permitting



Above, ball side of gear—Below, loading spring side of gear and loading spring assembly

the hub to turn free of the gear rim. The auxiliary spring, *S*, insures removal of the balls from the cups, *C*, once the balls have been forced out of the hub sockets by excessive torque demand. The balls are allowed to drop out between the arms and find their way to the bottom of the gear case, free of interference with the rotating member.

The seats on the hub member on which the gear rim rests in normal service are so designed that when the balls have been dislocated, the gear rim moves to the right as shown in the sketch, and downward, with the gear face resting on the gear case and clear of the rotating hub. The gear is, in view of this action, inherently "trip-free" in its operation and, hence, no renewal of parts after running for long periods with the balls displaced is necessary. Adjustment of the "pull-out" value of the gear may be obtained if desired, by varying the position of the plugs, *P*, in the gear rim sockets.

After an emergency operation, the gear can be restored to normal operating status by removing the gear case and replacing the balls in their sockets.

EDITORIALS

Improvements Necessary in Freight Handling Equipment

The Federal Co-ordinator's report on merchandise traffic, issued the latter part of March, contains several radical suggestions for revising this service on the railways, in the effort to reduce expenses and regain lost traffic. It recommends, among other things, the consolidation of rail l.c.l., express and forwarder traffics, and pooling all rail merchandise services into two competing agencies of comparable traffic and financial strength. It advocates, also, the collection and delivery of merchandise at the patron's door, simplified classification, liberalized packing requirements, less complicated rate structure, and the co-ordination of rail and highway traffic.

Obviously such changes will affect the mechanical department. One paragraph in the report, for instance, comments directly on equipment requirements in these words: "Rail equipment for the handling of merchandise should be modernized. For the present the express and baggage car equipment is sufficiently shock-proof and capable of sufficient speed for merchandise service, although excessive tare weight and deficiency in potential cubical capacity, dimensions considered, tend to make it obsolete. Temporarily, box cars can be made reasonably serviceable for transportation of merchandise by the installation of non-harmonic springs, improved high-speed brakes and wheels. As the present equipment, express and freight, wears out, it should be replaced with light, shock-proof equipment, primarily designed for merchandise service. This equipment should include containers, truck bodies and other units interchangeable between the chassis of rail and highway vehicles."

In another part of the report this statement is made: "The present box car is inferior, either to the motor vehicle or to rail express equipment, in its ability to protect the lading against shocks, oscillation and vibration. Methods and practices used in handling cars in freight trains and yards, such as switching, emergency brake applications and the like, also frequent transfers of lading en route, are further contributing causes of damage to rail l.c.l. freight."

Footnotes relating to the last mentioned quotation indicate that the American Railway Association has just completed road and laboratory tests of several non-harmonic springs for freight cars. The statement is also made that a number of private cars have been equipped with these springs, with successful results, and that the railroads are beginning to use them on box cars. Another note draws attention to the fact that the American Railway Association has now prescribed specifications for draft gears, so designed that they will absorb all end shock up to a speed between four and five miles an hour.

Many difficult problems are involved in the design and construction of the special equipment which in all likelihood will be required, if upon further study it is found advisable to adopt the recommendations made in this report. Certainly if costs of transporting merchandise are to be reduced to a minimum, with the highest possible standards of service, we must be prepared to depart from traditional methods and practices and take advantage of every new development that gives reasonable promise of insuring better results. The recommendations made in the Co-ordinator's report are a distinct challenge to railway executives, including mechanical-department officers and representatives who have the responsibility of providing and maintaining the cars and other facilities which will be required.

Business Increases— And So Does Locomotive Age

So far during 1934 orders have been placed for 20 locomotives by the railroads in the United States. This compares with orders for 42 locomotives during the entire year 1933 and for only 12 locomotives during 1932. But in comparison with the orders for other equipment —both freight and passenger cars—and with the general motive-power conditions, it is far from sufficient.

The total number of locomotives owned has been declining steadily, if not rapidly, for several years. The number of serviceable locomotives has likewise been declining steadily, but at a considerably greater rate. Whereas the number of locomotives reported on line January 1, 1933, was 51,724, and on January 1, 1934, was 49,637—a decline of something more than 2,000 locomotives—the number of serviceable locomotives dropped from 42,166 to 38,742, or nearly 3,500 locomotives within the same period. As there was no great change in the number of locomotives in service during this period, the difference has come out of the locomotives reported as stored serviceable which have declined from 9,387 on January 1, 1933, to 5,913 a year later.

The decline in traffic which took place during the last quarter of 1933 not only has discouraged the purchase of new locomotives, but has also postponed, and in some cases caused the contraction of, maintenance programs which were expanded last summer.

Since the turn of the year, however, there has been a definite upward trend in freight traffic which is greater than seasonal in amount. Freight train-miles in January, 1933, amounted to 30.8 million and in January, 1934, to 34.4 million. While figures are not yet available for the month of March, the relation between car loadings in January and March would indicate a freight-train mileage for the month well up to the peak of 36.5 million miles in last October.

While government activities, and particularly the apparent lack of understanding of the needs of the heavy goods industries, have created grave uncertainties during the past five or six weeks, there is a growing undercurrent of conviction that the forces of recovery are becoming irrepressible. There is reason, therefore, to expect this fall a new peak for the years since the beginning of the depression. An increase in the demand of four or five thousand locomotives could, on the face of the figures, be met from the more than five thousand locomotives now reported stored in serviceable condition. No such draft on this group of power could be made however; fewer than four thousand of these are freight locomotives, and many of the others cannot be used economically. Most of the increased demand would have

to come from the approximately eleven thousand locomotives now unserviceable. How rapidly can the railways reduce the accumulation of unserviceable locomotives while at the same time keeping up currently with the mileage being run out in increasing volume each month?

With over half of the locomotives owned more than 20 years old and not more than 17 per cent of them 10 years or less in age, economy in handling the increasing traffic requires that a beginning be made without delay on the restoration of life in the locomotive inventory by installing new locomotives at the top, as well as by removing the dead wood from the bottom.

Loss and Damage of Freight

Freight loss and damage for the year 1933 as reported by the Freight Claim Division of the American Railway Association for 148 carriers, representing 95 per cent of United States mileage and 60 per cent of Canadian mileage, shows a gratifying improvement as compared to previous years. Incidentally, it is the lowest since 1903. The total for 1933 was $15,485,440, as compared to $18,936,024 for 1932, and $13,726,508 for 1903. Noteworthy among the decreases for 1933, as compared to 1932, are those due to error of employees, 34 per cent; rough handling, 31.9 per cent; delay, 30.6 per cent; concealed damage, 30.3 per cent; improper refrigeration and ventilation, 29.6 per cent; loss of entire package, 27.7 per cent; and improper handling, loading, etc., 26.9 per cent. Unfortunately there were some items which showed increases during 1933. These were, robbery of other than entire package, 70 per cent; fire or marine loss or damage, 38.4 per cent; and freezing or heater failure, 15 per cent.

Why the increase in robbery? Is the mechanical department in any way responsible? What can it do, if anything, to assist in improving this record? In an attempt to answer the last two of these questions a railway officer in charge of the protection of property was interviewed, as reported on another page of this issue. Apparently there is not a great deal that the mechanical department can do, other than to maintain the equipment in the best possible condition. Aside from coal and coke, the largest items included under the head of robbery are tobacco, dry goods, clothing and textiles, boots and shoes, and other manufactured and miscellaneous items.

Progress In Mechanical Research

It is generally recognized that draft-gear research and tests, conducted by the American Railway Association and supplemented by that of individual manufacturers, have resulted in raising the standard of approved draft gears. To an increasing extent, as time goes on, this draft-gear equipment, adapted to modern requirements, will prove an important factor in reducing freight-damage claims of about $15,000,000 a year and car-maintenance expenditures of $120,000,000 a year.

Similarly, the modern type of cast-steel side frame, which means so much in increased reliability of operation and reduced maintenance, has been developed; also the improved Type-E coupler, with increased strength, wear limit and gathering range, and the AB freight brake which promises to effect important improvements in freight-train handling, as well as to reduce operating and maintenance costs.

Sample box cars built to the A. R. A. improved standard design, whereby almost two tons of weight are saved without loss of strength, have been subjected to load and impact tests to develop any potential weaknesses in the design and also as a guide for further improvements. These A. R. A. standard car designs, when placed in general use, will prove an important factor in enabling the railroads to give more satisfactory service at substantially reduced operating and mechanical maintenance costs.

With increased freight-train speeds, the problem of vertical oscillation on truck springs became acute and numerous spring-snubbing devices were developed by manufacturers and offered to the railroads as a solution. In an effort to determine the qualities and operating characteristics required in this type of equipment, the A. R. A. recently conducted laboratory tests of several different designs at the A. R. A. laboratory at Purdue University and supplemented these laboratory tests with extensive and scientifically conducted road service tests at Rochester, N. Y. The preliminary report of the subcommittee on this development has just been completed and will doubtless prove of substantial assistance to the railroads in determining what kind of spring suspension and spring snubbing equipment is required on freight cars subject to modern high-speed operation.

Condensation tests are now being conducted by the A. R. A. in an effort to find a solution to the problem of sweating in box cars with steel roofs when loaded with such commodities as flour or hot cereals. Road service tests with cars equipped with various types of protective materials under the car roof are being conducted in an effort to avoid this sweating and attendant damage claims which are at present reaching substantial figures.

How Near Ready Are You?

The past few years have been trying ones for both men and management. Locomotives have been run as long as they could be kept on the road, then stored awaiting repairs at some undetermined future date. Every effort has been exerted to keep the latest and most efficient power in operation, for, despite reductions in car loadings, freight trains were being moved at steadily increasing speeds. Shop forces have been pared to the bone and deferred maintenance has continued to pile up from month to month to new heights. In some instances back shops have been closed down entirely and the job of maintaining locomotives, even to making classified repairs, has been unloaded onto the enginehouse forces.

After a long period of waiting it can be said that the tide has now definitely turned. Aided by federal loans in many instances, a number of roads are now inaugurating definite plans for rehabilitation of power and equipment. Other roads which so far have recalled but few men are working out plans which will necessitate the reopening of additional shops in the near future. Some of the smaller and less well equipped shops that have been closed down probably never will be reopened again. The work which they formerly did will be transferred to the larger or more centrally located shops, thus throwing an added load of work on such shops. This will tend to make these shops to a certain extent manufacturing points

for the supply of finished or partly finished parts to outlying points and will cause some changes in the character of the work performed.

Assume that you are responsible, for example, for the operation of a railroad machine shop and realize, as you must have that the time is soon coming when the shop will be required to turn out considerably more work than has been called for in some time. The vital question at the moment is, therefore, are you, or will you be, ready to meet the situation when the time comes. Men can be obtained, and while the building up of a shattered personnel will undoubtedly be a trying one in many cases, the difficulties can be surmounted. What about the physical condition of the shop as regards layout and machine-tool equipment? Possibly you feel that you know the shop thoroughly, its capabilities and also its shortcomings. However, would it not be a wise move at this time to stop and take a complete inventory of conditions as they are? Why not study the floor plan and arrangement of machine tools. Are they suitably placed for convenient and economical reception of materials from the storehouse and for the handling of parts from and to the erecting shop? Are aisles adequate and marked out by white lines so that they may be kept clear and free of stored materials? Is there a sufficient number of power trucks and other means for moving materials and are they of the kind best suited to your needs? Are cranes, both overhead traveling and supplementary, together with all types of hoisting equipment, sufficient? Is the air supply adequate and are there a sufficient number of suitably located outlets? Are there enough electrical outlets for attachment of portable tools and lights and are they properly located? Are provisions for driving machine tools satisfactory? How about special machines, attachments for machines, tools, jigs, etc.? While at it, do not overlook the toolroom. Its needs should also be investigated. Questions of lighting, heating, ventilation and toilet facilities are also important as they have material bearing on shop morale.

By making such a rigid inspection, taking ample notes and placing them in writing as though for a report it is more than probable that things which have been overlooked, perhaps for years, will be found and you will then be far better prepared to cope with the inevitable demands which the future will have in store. The most important deficiencies can receive attention first and as new equipment can be purchased suitable stress can be given to the procurement of the machines which will be most effective in increasing output and the reduction of shop costs.

A Problem— What of the Solution?

The steam locomotive is the most important operating factor with which a railroad has to contend, for upon the ability of its motive power to produce transportation economically depends the railroad's chances to operate at a profit. There may be those who will dispute such a statement but the cold fact remains that three of the largest items of railway operating expense—locomotive repairs, locomotive fuel and enginemen's wages—relate directly to steam locomotives and together represent one-quarter of all the money spent for railway operation.

It has been pointed out repeatedly during the past three years that if the railroads are to operate at a profit in the future they will undoubtedly have to do so by effecting economies for they can no longer depend upon increases in traffic due to national and industrial expansion—that period ended about 1918.

Fortunately the opportunities for effecting economies lie within the province of the mechanical department and whether or not these opportunities are grasped will depend in a large measure upon the attitude which mechanical officers adopt toward motive-power problems.

As business improves, and it can not now be denied that it is improving, mechanical men are faced with the necessity of deciding immediately whether they are going to invest money to secure future economies or keep on spending it with no return. Every locomotive over 15 years of age presents an individual problem concerning which a decision must be made as to whether it will be returned to service or retained in service with the definite knowledge that for every mile it runs it will cost the railroad money that might otherwise be saved if it were replaced with a modern unit.

Elaborate studies have been made which indicate the potential economies of modern power and the operating experience of roads with modern power substantiates the indications of these studies. There is now no question as to the ability of modern power to contribute to savings in fuel and increases in the capacity for hauling heavier trains at higher speeds.

The locomotives that have been placed in service within the past 10 years have demonstrated conclusively that they can be maintained for considerably less than older power. Analyses of the repair costs of more than 10,000 locomotives, made by the Baldwin Locomotive Works, indicate that a 20-year-old locomotive costs nearly twice as much to repair, per potential work unit as a locomotive three years old and more than four times as much as a locomotive just installed in service.

What is true of locomotives is just as true concerning locomotive repair facilities. During the past five years, while the railroads, because of declining revenues, have given little attention to the problem of adequate repair facilities, the machine tool and shop equipment industries have been making steady progress in the development of modern equipment and methods. In looking into the future the mechanical man can no longer ask himself whether he can afford to use the money which increased railway revenues are bringing by investing in modern shop equipment, but must decide immediately whether he is wasting his company's money by retaining in service obsolete machine tools and shop equipment.

The basis on which the railroads developed during the period of the expansion of facilities has resulted in the building up of locomotive repair plants representing an excess of capacity in obsolete equipment the existence of which has encouraged the growth of many uneconomical practices. The problem of future economies in locomotive repair work is one which can best be approached by a consideration of the desirability of consolidating facilities and concentrating repair operations at centralized plants where the volume of work will be sufficient to enable the roads to take advantage of the potential economies of modern repair equipment.

While locomotive repairs involved an expenditure of only 193 million dollars in 1932—as compared with 409 million in 1929—a part of the difference was at the expense of an accumulation of deferred maintenance now amounting to more than 200 million dollars. What assurance have we that by 1938 the locomotive repair bill will not represent a greater proportion of total operating expenses than it did in either of these former years? Certainly this will happen unless measures are taken to effect improvements in keeping with those already made in other phases of railroad operation. The problem is clearly defined—what is your plan for its solution?

THE READER'S PAGE

Threads for Staybolt Taps

To the Editor:

In regard to staybolt taps, I should like to ask a question about tapping out overhead holes. The railroad company for whom I have worked for years always buys five-fluted spiral taps, V thread. Before a new tap can be used we are obliged to take it to the toolroom and have it backed off; we never can use a new tap without doing this. What is the reason for this? I have tried to find out but nobody here seems to know. The shop is not fixed so that we can turn the boiler over and tap holes as is done in the larger shops. We go up and tap down. If we use a new tap without backing it off first, it will ream out and flatten threads. After being backed off, however, we get a good thread. I wish the company would use U. S. threads or Whitworth threads and we would have more success fitting bolts—V threads are too sharp. I hope you can enlighten me on this matter.

Ralph G. Shultz.

Why Cross-balance? An Answer

To the Editor:

In your March issue a correspondent under the initials G. E. discusses locomotive counterbalancing. He concludes by saying: "Surely this subject should be better understood." I thoroughly agree and offer, for example, G. E.'s statement: "Why cross-balance anyway? If there results any reduction in dynamic augment, the decrease is accomplished by reducing the percentage of reciprocating weight balanced." This shows a complete misunderstanding of the subject. It is possible, by cross-balancing, to reduce the dynamic augment and at the same time to suppress a couple which acts in the same direction as the inertia force of the reciprocating parts. In effect the dynamic augment is reduced and more balance provided for the reciprocating parts.

This can be seen from Fig. 1, part 43, of your February issue. Consider a pair of main wheels with rotating parts, as shown in Figs. 1a and 1b. The rotating parts have an equivalent weight of 2,490 lb. in each wheel. The inertia effect of these parts is equivalent, as shown in Fig. 1b, to two equivalent weights in each wheel, one of 2,870 lb. at the crank pin, the other of 380 lb. acting 90 deg. back of the pin. The wheels would be statically balanced by adding an equivalent weight of 2,490 lb. in each wheel directly opposite the crank pin. This would leave a dynamic unbalance in each wheel corresponding to an equivalent weight of 380 lb. acting along the crank and an equal weight acting 90 deg. back of the crank. The resultant of these producing dynamic augment is 537 lb., which, at diameter speed, will develop a force of about 25,000 lb. The equivalent weight acting along the crank, together with the equal and opposite equivalent weight in the other wheel acting in the same plane, produce a couple which supplements that due to the inertia effect of the reciprocating parts.

Now if the rotating parts are cross-balanced, or, in other words, dynamically balanced, the dynamic augment will be eliminated. The balance provided for the reciprocating part will not be reduced as stated by your correspondent. On the contrary, the effect will be to reduce the torque which would otherwise work with the inertia effect of these parts.

Many of the other statements made by your correspondent are equally poorly founded on fact. One of them, however, I accept. This subject should be better understood.

Lawford H. Fry,
Railway Engineer, Edgewater Steel Company,
Pittsburgh, Pa.

In Defense of "Dave" and "Alec"

To the Editor:

The person who signed himself "A Car Inspector" in a letter published in the February issue of the *Railway Mechanical Engineer* sounds like the same person who, when he found himself in jail on some imaginary offense yelled, "you can't lock me up." Well, anyway he was in, and likewise there *are* such characters as "Dave and Alec."

Should only educational and inspiring articles be printed in the *Railway Mechanical Engineer,* and in other periodicals as well, writing and printing would soon be among the lost arts. Certainly even a car inspector would bemoan such a condition. In fact, what would become of all the humorists and would-be humorists that infest the country? Our comic artists would likewise be extinct. When an article of the "Dave and Alec" type appears, it brings to the mind of the experienced car inspector some of the foolish things he did in his early years, or some similar action on the part of fellow workers. Certainly it is no reflection on car inspectors as a group to relate such experiences; one does not have to stretch his imagination to the breaking point, if he has really been around where cars are interchanged, to recall in the not too distant past that things just as foolish have happened at some of our largest interchange points.

"Dave and Alec" would look like amateurs in comparison with some of our big shots when it comes to misinterpreting the A.R.A. rules. If there were no such characters, A.R.A. Supplements to the Rules, Arbitration Decisions or the present interpretations after the rules as now printed would be as unnecessary as radio crooners.

"Dave and Alec" may not know the rules and probably not the address of an up-to-the-minute car inspector, but they certainly are true to life, and human. Otherwise why all the A.R.A. Committees on Rules?

I doubt very much if "Dave," or even "Alec," ever heard of a Wheel and Axle Manual, but one of them must have been on speaking terms with intestinal fortitude and wouldn't take a chance.

Just Another Inspector.

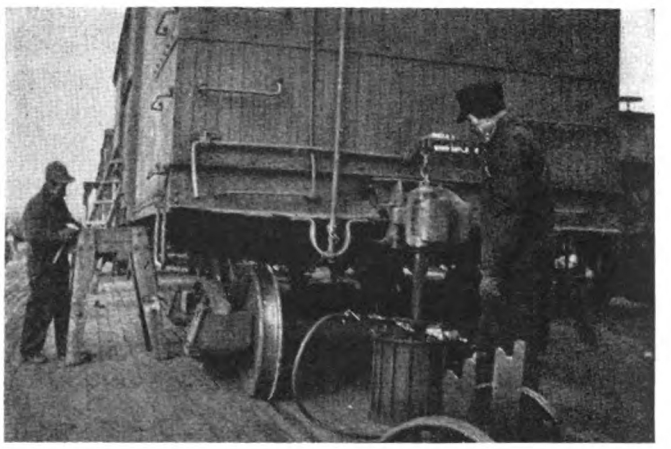
With the Car Foremen and Inspectors

Improved Method of Making Wheel Changes

ONE of the most important operations in freight car repairs is the proper application and removal of freight car wheels in such a way as to avoid bruising the highly polished car journals and at the same time keep the labor cost and delay at a minimum. During recent months the Chicago, Milwaukee, St. Paul & Pacific has made a particular study of this subject and installed improved equipment and methods at a number of car repair points such as Bensenville and Galewood, Ill., West Clinton, Ind., South Minneapolis, Minn., etc. Special equipment, now being built for other points also, includes an air jack to save labor in jacking cars; a special truck-assembling device which saves labor as well as avoids possible damage to the journals; a wheel carrier for conveniently moving the wheels (without the use of a wheel stick, or rolling in soft ground) from the standard gage track to the cleared roadway beside the car; and an electric lift truck which is a great labor-saver in handling wheels to and from the wheel shop, wheel storage tracks, or supply car.

Referring to the illustrations, the construction and use of all of these devices are quite clearly shown. The air jack consists simply of a large 14 or 16 in. air cylinder reinforced with tie rods between the cylinder heads and supplied with air through the usual rubber hose connection from the shop air line. This jack is placed under the coupler pocket casting on one end of the car, upward movement of the piston and rod easily raising the car without the manual labor involved in hand jacking. As a safety measure, suitable wooden horses and blocking are used to follow up under the car sides as the car is raised, similar precautions being taken in lowering the car again, after application of the repaired truck.

With the car resting on the horses the bad-order truck is rolled from under car and is ready for dismantling by means of the device shown in another illustration. This device consists of a riveted metal framework supported on four legs and carrying three chain hoists suspended from rollers and capable of movement along the horizontal bar. The device is 10 ft. 3 in wide and 6 ft. 9 in. high overall, the height under the horizontal bar being 5 ft. 2 in. The legs, spaced 2 ft. 6 in. apart at the bottom, are made of 1½-in. angle iron, joined at the top by rivets to a ½-in. triangular plate. A strap made of ¼-in. by 1½-in. iron, is bent to the shape

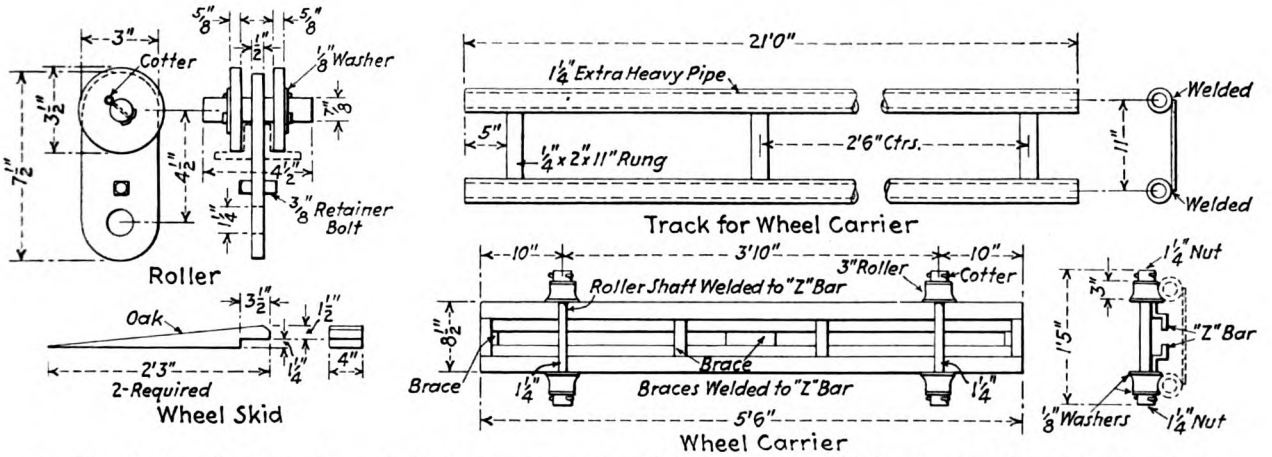


Air jack used in raising cars for the removal of trucks needing repairs

shown and riveted at the top and bottom to the lower part of each leg to give increased bearing surface on the ground and thus avoid the necessity of special blocking.

The horizontal bar, mentioned, consists of two 1½-in. angles, spaced slightly over ½-in. apart and supported by four steel tie bars from an overhead arch made of ½-in. by 2½-in. steel, bent at the center and also at each end where it is firmly riveted to the horizontal angle irons and to the top of the triangular end plate, which is bent over 3½-in. to provide the necessary support.

The spacing of the horizontal angle irons provides for passage of the ½-in. by 3-in. by 7½-in. vertical steel strap which is suspended from each pair of 3½-in.



Details of the wheel carrier and track arrangement which greatly facilitates the handling of car wheels

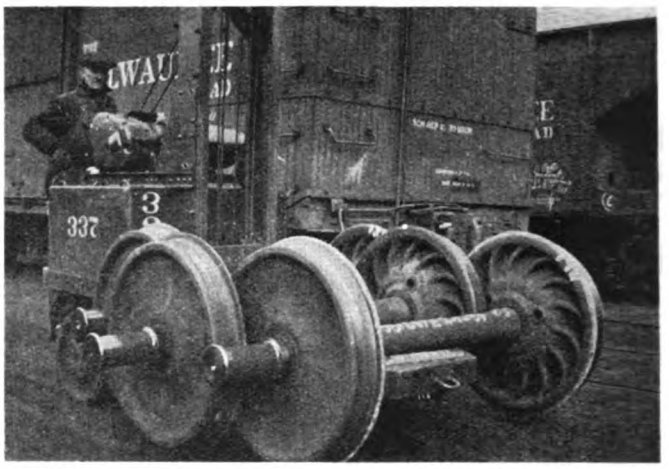
rollers and which forms the hoist support. The double rollers, of course, move on and are held in place by the angle irons. The vertical straps and roller assemblies are kept in place on the angle irons when the device is being moved about the repair tracks by means of a ⅜-in. retainer bolt in each strap.

It will be noticed that the space in which the center roller can move crossways of the device is somewhat restricted, but ample for the requirements. The two outside rollers also do not have full travel along the angle irons, but can move a distance which is entirely adequate for the purpose intended. While other types of hoist can be used with this device, the particular ones illustrated are of a ¾-ton capacity and of a convenient lightweight roller-chain and sprocket design, made by the Coffing Hoist Company, Danville, Ill.

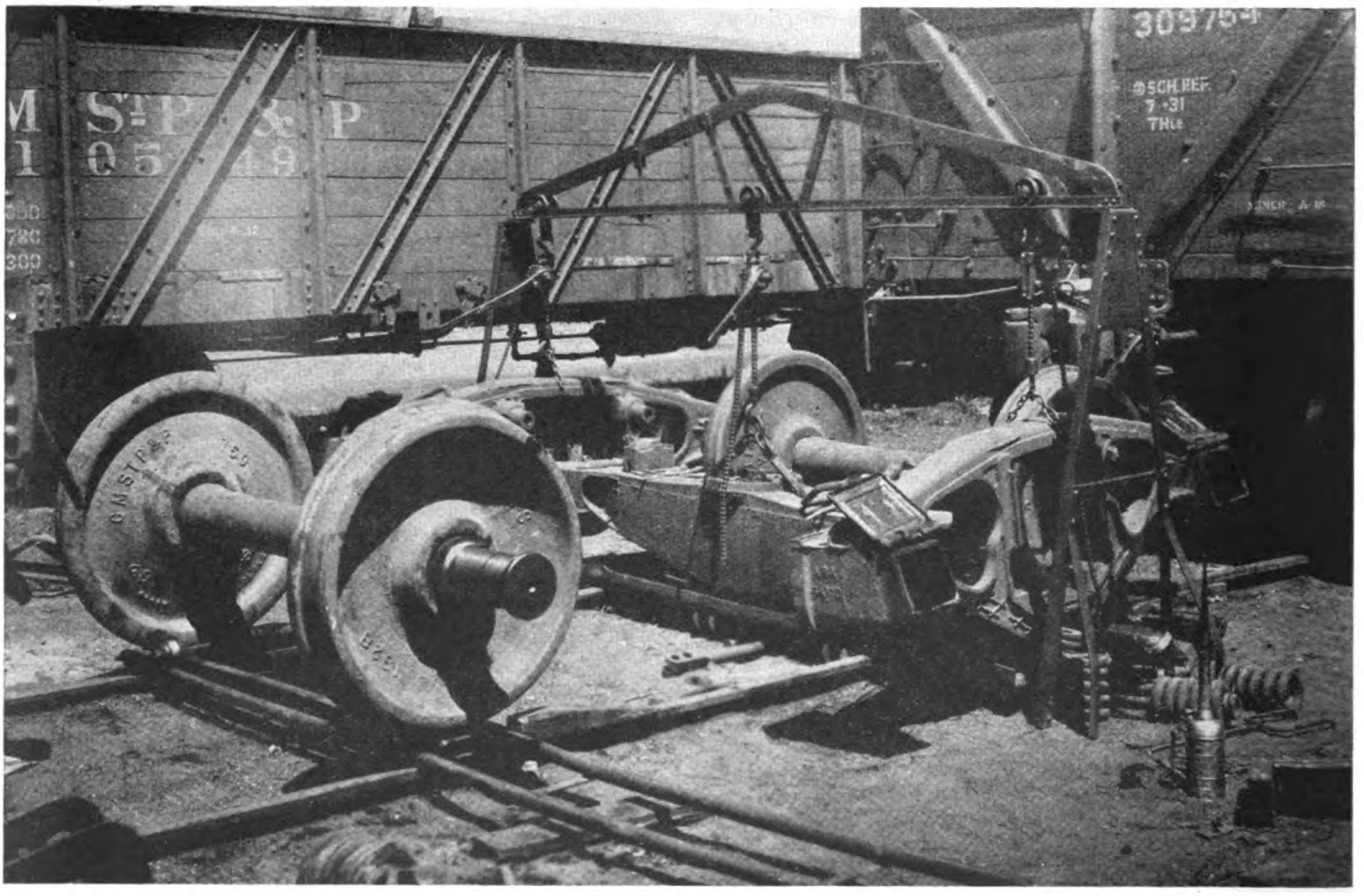
In operation, the center hoist is connected to the bolster and the two outside hoists to the side frames which can be readily lifted and pushed off over the journals, since the weight is supported on rollers. The reverse operation is used in re-assembling the trucks.

This device can be easily carried from car to car no matter where located and it is not necessary to have concrete or plank roadways. It can be used for removing and replacing any truck parts as well as brake beams which can be done at the time of the wheel changes if necessary; it is easily controlled and operated by two men affording sufficient power to raise the truck sides or frames and bolster; it eliminates possible damage to car journals and dust guards when removing or replacing the truck sides. It also supports the truck bolster at the proper elevation so that the truck springs and blocks can be readily removed.

The hoists hold all parts in convenient working position so the operator can remove and replace the dust guards and clean out the journal boxes of old grit and packing. It further prevents the possibility of grit or particles of packing falling on the journals prior to the application of the journal bearings, thus greatly assisting in the reduction of hot boxes and train delays. One of the important factors in the operation of this device is accident prevention, due to the practical elimination of heavy lifting as well as possible injury to hands or fingers in removing and replacing journal bearings and wedges.



Electric lift truck which saves labor by handling three pairs of wheels at one time



Convenient truck assembling and dismantling device used at a number of car-repair points on the C. M. St. P. & P.

Another novel feature of this method of handling

truck repairs consists in the special wheel carrier used to move the wheels from the standard gage track laterally to a roadway where it can be subsequently moved by truck to the wheel shop. This wheel carrier consists of a built-up structure made of Z-bars, 5 ft. long, welded into a rigid framework by means of suitable cross braces and arranged to move on four rollers, which are supported and roll on two pieces of 1¼-in. extra heavy pipe, spaced 11 in. on centers, and held accurately to this gage by means of welded cross braces spaced every 2 ft. 6 in. Oak wheel skids are used to assist in rolling the wheels onto the wheel carrier, which is then readily pushed across the track as required. The lift truck then takes the wheels, two or three at a time, if available, for movement to the wheel shop.

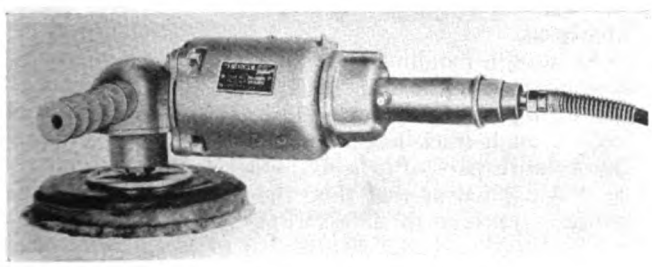
Comparative figures for the complete cost of changing one pair of wheels by the former methods and by those described are shown in the accompanying table. It will be noted that the use of this device resulted in a saving of 67 per cent of the previous cost.

Comparative Cost of Changing One Pair of Freight Car Truck Wheels

Operation	Old Method	New Method	Saving
1—Jack up car, remove truck including obtaining jacks, blocks and horses	$0.31	$0.11	$0.20
2—R. R. & R. packing, cleaning journals	.10	.10	
3—Dismantle truck, R. R. & R. dust guards	.39	.15	.24
4—R. R. & R. wheels	.14	.03	.11
5—Reassemble truck	.66	.27	.39
6—Shove truck under car, jack down, remove horses, blocks, etc.	.27	.11	.16
7—Take scrap wheel from car after removal to scrap wheel storage and return with new wheel to car	.70	.07	.63
Total time consumed	4 hr. 26 min.	1 hr. 30 min.	
Average number of men used	4	2	2
Total cost	$2.57	$0.84	$1.73

Electric Polishing and Sanding Tools

THE Buckeye Portable Tool Company, Dayton, Ohio, has developed a new high-frequency electric portable tool for rubbing down and polishing lacquer. The No. 57-1800 polishing and rubbing tool has a speed of 1,800 r.p.m. and is ordinarily furnished with a two-



Hercules No. 57 polishing and rubbing tool

phase, 180-cycle, 225-volt motor, although a 110-volt motor can be supplied if so desired. Either 8-in. or 9-in. discs with rubbing pad or lamb's wool may be used. The overall length is 16¼ in. and the weight 10½ lb. An effective ventilating system adds to the ease of operation and is arranged to blow the dirt away from the operator. Another special feature is the renewable insulating pad which supports the rotor, it being so designed that it can be replaced without loss of the housing.

The No. 56-4700 sander is identical in construction with the No. 57 tool except that it is speeded to 4,700 r.p.m. and is equipped with abrasive discs or cup emery wheels for sanding or grinding.

The Supervisor in Accident Prevention

*By F. J. Swanson**

THE railroads have accomplished a wonderful feat by reducing their injury claim payments to employees and the public about $30,000,000 in the past 10 years. Accident-prevention is not an embroidery fringe on production; it is an integral and, therefore, an important part of production. Safety of employees and others must be considered first in order to have a successful and efficient operation. Safety records, already achieved, can be still further improved.

First of all, the department head must feel and assume his responsibilities and become entirely sold on the idea. The matter of providing a safe place for men to work is put squarely up to the supervision. The result will depend entirely upon our intelligence, watchfulness, careful planning and the application of corrective measures. It is important that each supervisor personally know that every employee under his supervision possesses normal hearing and sight in order to be a safe employee. It is also the responsibility of the supervisor to see that tools and other facilities are in the best possible condition.

A supervisor should be gaged by the way he plans his work in a safe manner, thus avoiding injuries. One who has no accidents almost always can be counted upon to have a good operation in other respects. We pick a supervisor because he possesses some exceptional all-around ability or qualifications that make him an outstanding figure among the group he is to lead. He is expected to be thorough, efficient and decisive, ready to give intelligent, constructive advice at all times to those in his charge. Failure in part to perform what is expected of him results not only in loss of efficiency, but in a breakdown in the morale of the men. In plain words, we cannot expect men to follow a leader who talks safety at safety meetings and then feels, because in charge, he is entitled to special privileges.

Men look to their leader to be outstanding. He must be thoroughly familiar with every safety rule applicable to his departmental work. He must see that they are all put in effect. He must continually watch all working conditions, both for unsafe and safe practices and equipment, making immediate correction where found unsafe, and using the benefit of a safe practice as an educational feature to promote further safety throughout the department.

A method of further training and education of foremen should be so perfected as to insure the company that each crew is protected by at least one 100-per cent safety man. Through his complete knowledge and understanding of safety practices, he is able, as a leader, to bring about the desired results.

Any accident, trivial as it may be, should be taken with the seriousness of a major accident. Perhaps an inch or less was the only separation between the slight mishap and what might have been a reportable injury. A man experiencing only a slight mishap should not be allowed to continue work with only a casual shake of the foreman's head to denote his disapproval but, on the contrary, should first be talked to until he fully understands the safe method of doing his work. A good constructive safety talk to a man like this will do much to help him, as well as others in his crew, who will find him trying to execute his work in a safe manner.

The very essence of accident-prevention work on the

* General car department supervisor, Chicago, Milwaukee, St. Paul & Pacific, Minneapolis, Minn.

part of the supervisor lies in the analysis of accident data and the development of preventive methods. Some of the undesirable conditions which may be found are as follows: Improper instruction to employees, lack of team work, poor discipline, playing on the job, chance taking, undue haste, unsafe practices, inadequate tools and facilities, improper working conditions, improperly piled or stored materials, congestion, poor illumination and poor housekeeping, improper handling or layout of operations, use of methods unsuitable for the work and improper dress or apparel, such as loose clothing, sleeves and poor shoes.

In order to secure the most desired and efficient results, the highest type of co-operation is required at all times between the executive heads, supervisors, employees and all individuals, as well as advisory groups. Further success can be achieved by all being "safe minded."

Air Brakes in Passenger-Train Service*

By H. T. Wentworth†

PASSENGER trains were satisfactorily controlled with low pressures until 1894, in which year the high-speed brake was introduced to provide greater safety for increased car weight and faster train schedules. The brake-pipe pressure was increased from 70 lb. to 110 lb., making possible three applications of substantially the same value without recharging. The high-speed reducing valve was added for the purpose of limiting service applications to a brake-cylinder pressure of about 60 lb. and automatically to blow-down maximum brake-cylinder pressure to about 60 lb. following an emergency application.

This equipment was superseded by the LN equipment in 1908, the improved features of which were graduated release, quick recharge and high brake-cylinder pressure during emergency applications. The introduction of heavy steel passenger cars, however, made it necessary to apply two separate brake equipments or resort to a brake cylinder exceeding 18 in. in diameter. As the use of a larger cylinder was objectionable, double equipment became imperative.

During tests in 1909 the PC equipment was introduced, making possible the control of cars of maximum weight with a single brake cylinder, whereas it had been necessary to provide double LN equipment. The PC equipment was designed to operate with 110 lb. brake-pipe pressure and develop 86 lb. service brake-cylinder pressure, but as the initial brake-pipe pressure was decreased, the brake-cylinder pressure and braking force was decreased correspondingly.

In 1913 the UC equipment was introduced and it incorporated all the advantages of the PC equipment, with the exception of the maintaining feature which was found necessary. Increases in passenger-train weights and speeds were followed by modifications in the U-12 valve and 6-ET locomotive brake equipment and the application of release chokes to the PM, LN and PC equipment, making the operation of brakes throughout the train so harmonized as to greatly reduce slack action, and thereby improve the smooth handling of the train.

When these changes were made the U-12 valve was known as the U-12-B. Recently a strainer cap was provided for the equalizing portion to eliminate failures which were caused by dirt and scale in that portion, and also to improve the action of the valve between cleaning dates and by its installation the U-12-B valve then became known as the U-12-BC. This strainer cap proved so satisfactory that a strainer portion has now been developed and is recommended for the emergency portion. With its application the symbol of the valve has been changed to U-12-BD.

Other Causes of Rough Handling

With all the improvements in air-brake equipment and the method of handling there are some things which cause failures and complaints of rough handling which cannot be directly charged to, or eliminated by air-brake devices, a few of which are:

(1) Accumulation in winter of snow and ice on body brake levers due to draughts and suction created by the motion of the train lifting the snow which mingles with steam and water emitted from steam-heat equipment, thaw-out devices, waste connections, etc., together with such steam leaks as may exist at couplings between cars, all of which blow up and around everything underneath cars, settling upon every inch of space and building up at times to immense proportions where it freezes and must be chipped off and thawed out on arrival at terminals. Such conditions often result in destroying a considerable proportion of the braking forces and at other times may cause brake shoes to drag to such an extent that unduly high wheel temperatures are often found under these conditions.

(2) Formation of ice on the drain cocks of reservoirs which has been known to weigh as much as 150 lb. often leads to failures when an inspector attempts to remove the ice with a hammer or when it is hit by other pieces of ice that may from time to time become loosened from underneath the car when the train is in motion.

(3) Handling of cars in switching yards without being particular to see that all brakes are properly released or no brake shoes frozen to the wheels is often the starting point of slid flat spots.

(4) An emergency brake application necessitated to avoid striking automobiles at grade crossings, or other causes, especially at low speed, is another cause for slid flat wheels.

(5) Rough handling of trains often charged to poor manipulation of the brake may be caused by excessive slack in improperly maintained draft gear.

(6) Rough track has a tendency to cause the load on one or more pair of wheels to be changed, and if the brake is applied at that time these wheels are liable to start and continue to slide as long as the brake remains on.

(7) Under winter weather conditions with extreme cold and snow it is difficult to make schedule time and the engineman is inclined to make up this time by entering the stations at which stops are to be made at a speed which necessitates a heavy brake-cylinder pressure being used up to the moment of stopping. This tends to cause the stop to be rough and wheels to slide.

(8) Numerous failures are caused by lack of attention in blowing all scale and iron chips out of the piping before it is connected up, when cars are in the shop for general overhauling, on repair tracks, or when purchased new.

The brake equipment for passenger train cars is so designed that the maximum calculated pull between brake shoe and wheel is never equal to the calculated pull between the wheel and the rail, so when rail con-

* Abstracted from a paper presented at the March, 1934, meeting of the Eastern Car Foremen's Association.

† Service engineer, The New York Air Brake Company.

ditions are normal and the car weight is uniformly distributed on all wheels in the truck they will not slide with a predetermined maximum brake-cylinder pressure. It is only possible for wheels to slide when rail conditions are below normal or when a part of the weight is temporarily removed from one or more pairs of wheels due to sudden changes in slack, rough track or passing over frogs, etc. Therefore, when rail conditions are below normal see to it that the engineman is allowed sufficient time in making stops so that it can be done with a low brake-cylinder pressure after speed is reduced or at point of stopping. Then if rough handling or slid flat wheels occur it is always well to check loose slack in draft gear. When irregularities occur, attention is usually centered on air brakes, but in many instances it is doubtful if sufficient importance is attached to contributing causes.

Due to the recent depression it has been a struggle for air-brake supervisors to maintain a sufficient supervisory force. An air-brake foreman is no less important from the point of view of economy than any other foreman; his information conveyed to others will frequently avoid the removal of a device which may be in no way responsible for some defect incorrectly reported. There never was a time when the work of cleaning and testing brakes was so important as at present.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Loose Wheel and Cut Journal— New Wheel Betterment Charge Sustained

The Seaboard Air Line shopped a Southern Railway car on account of cut journal. In making repairs new wheels and a second-hand axle were applied and bill rendered the Southern for the difference in value of two new wheels applied and two second-hand wheels removed, showing on their billing repair card one second-hand wheel, one loose wheel. Exception was taken by the Southern to betterment charge on the ground that the wheel reported as loose was not a condemned wheel in the sense that it was to be scrapped and further that the removal was on account of a cut journal—a delivering line defect—and this has preference over an owner's defect. Failing to agree, an appeal was made for a decision as to whether or not a loose wheel as covered by Rule 81, which can be remounted for service, is to be considered as condemned on account of owner's defect, or whether handling line should assume all liabilities on account of repairs made primarily on account of delivering line defect. It was the contention of the Southern that wheels were removed primarily on account of cut journal, at which time the car repairer reported one wheel loose on indication by oil seepage; that second-hand credit was allowed for the reason that both wheels were serviceable and were afterwards reapplied; and furthermore that a cut journal was a handling line defect and consequently the handling line should assume the entire expense in connection therewith. The Seaboard, on the other hand, while acknowledging the cut journal as a handling-line defect, contended that a loose wheel as listed under Rule 81, 1931 Code, is a bona fide owner's defect and whether or not the loose wheel is untfi for further service on that axle does not enter into the question of whether the wheel can be classed as condemned on account of being loose on that particular axle.

In a decision rendered April 7, 1933, the Arbitration Committee said that: "Rule 81 clearly establishes loose wheel as owner's responsibility. Rule 98, section (b), paragraph (2), establishes proper charge and credit for owner's defects in connection with cut journal. The charge of the Seaboard Air Line is sustained."—*Case No. 1725, Southern Railway vs. Seaboard Air Line.*

Responsibility for Alleged Wrong Size Arch Bar

The Southern Railway rendered a bill to the Seaboard Air Line for applying a bottom arch bar 1½ in. by 4½ in. to replace one found broken on an 80,000-lb. capacity gondola. Billing repair card was returned with joint evidence card showing arch bar standard to car "1¾ in. by 4½ in. or 5 in." After exchange of correspondence without effect the Seaboard billed the Southern under Rule 13 for replacement due to wrong repairs to offset original charges made. In appealing for decision the Southern claimed that the bar applied was the same size as the one removed, that the joint evidence card was issued under a mistaken impression that Rule 26 made mandatory the use of A. R. A. arch bar sizes in event of renewal, and that the Seaboard had arbitrarily changed the standards for their cars to those of the A. R. A. standard arch bars, but were applying A. R. A. standard bars to their cars only in cases where renewals were required or in case of alleged improper repairs. The Seaboard, on the other hand, contended that the application of a bar 1½ in. by 4½ in. constituted an improper repair in that it conformed neither to the original equipment size, 1⅜ in. by 4½ in., nor with their present standard size of 1¾ in. by 4½ in.

In a decision rendered April 7, 1933, the Arbitration Committee said that: "The joint evidence card is deficient for the purpose of establishing responsibility of the Southern Railway in that it fails to show location of bar for which wrong repairs is claimed, or whether it was a top or bottom bar. It also shows that the size standard to the car was 1¾ in. by 4½ in. or 5 in., which latter statement is in conflict with the brief submitted by car owner. The contention of the Seaboard Air Line is not sustained."—*Case No. 1724, Southern vs. Seaboard Air Line.*

Active Demand for Box Cars.—Business may have been a little dull, until recently, for manufacturers of freight cars, but the demand for one type of box car has been consistently active, depression or no depression. Ever since the War, the yearning on the part of returned American soldiers for replicas of French box cars of the "40 and 8" variety has been unabated. In fact, it is said that approximately 100 reproductions of the tiny French box cars are constructed each year in the United States from blueprints furnished by the French State Railways. What purpose these cars serve during the greater part of the year is an open question, but during the annual conventions of the American Legion they are much in evidence.

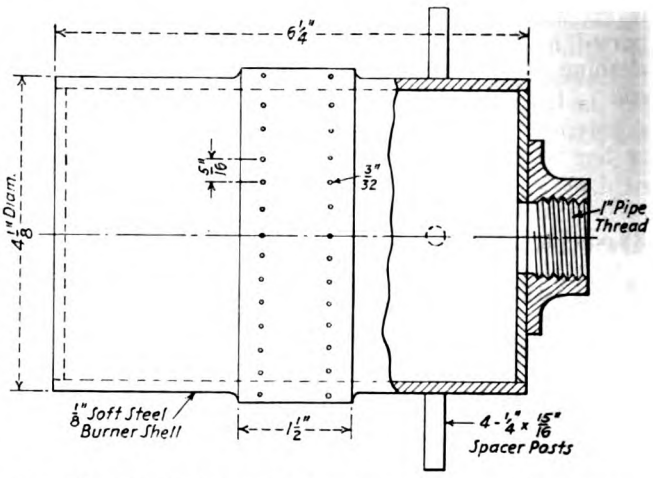
In the Back Shop and Enginehouse

Bending Large Pipe

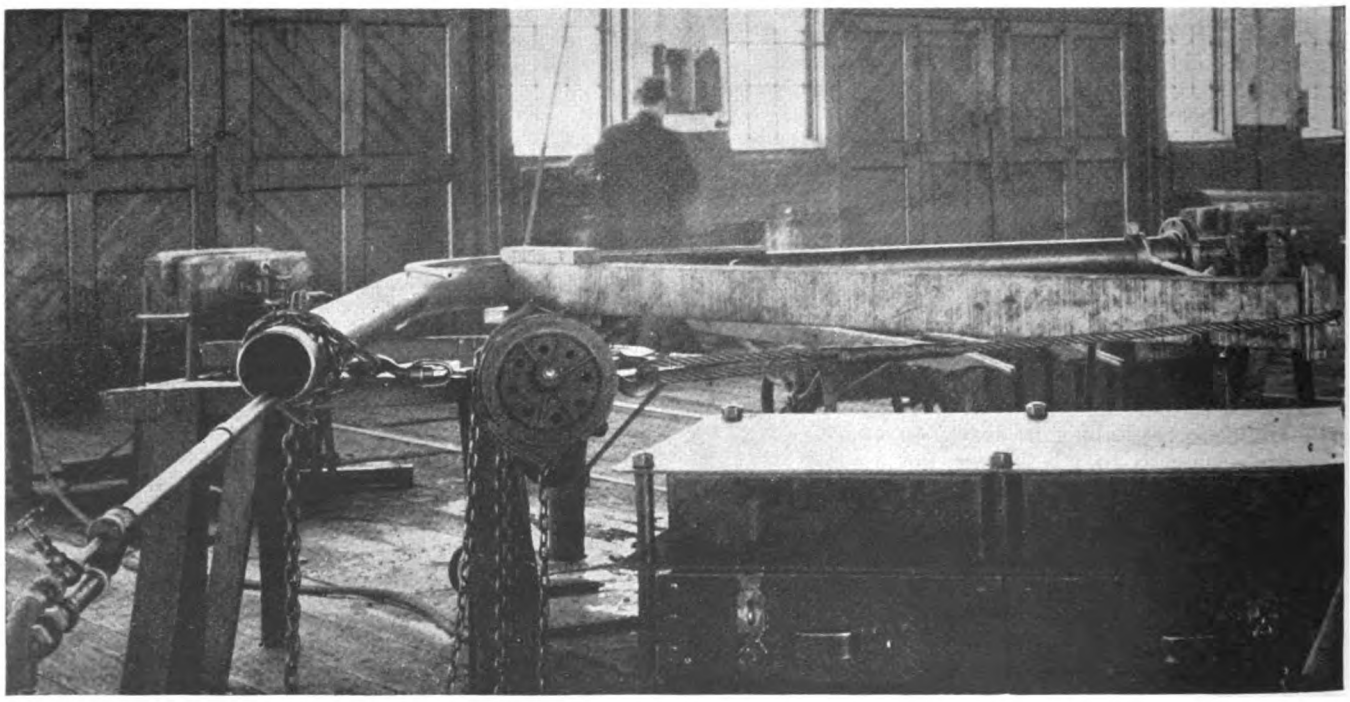
AN effective method now being used at the Milwaukee shops of the Chicago, Milwaukee, St. Paul & Pacific for bending large pipe involves the use of an internal burner or heating device which appears to work quite satisfactorily. The pipe bent comprises pipe over 4 in. in diameter and used for feedwater heater lines, expansion bends in power-plant piping and other similar applications. For this large pipe, the bow method of bending is used which consists essentially of connecting a steel cable and chain falls to the two ends of the pipe with a beam or "arrow" bearing against the steel cable on one end and against the middle of the pipe at the other end. The entire arrangement is supported on horses at the proper level for convenient work.

In general, the method of operation consists of applying the internal heater to the point where it is desired to begin the bend and, as soon as the pipe becomes hot at that point, tighten the wire cable by means of the chain falls until the pipe is bent slightly. The internal heating unit is then withdrawn slightly and the pipe again bent, this process being continued until the complete arc desired has been made in the pipe. It is important to keep the inner radius of the pipe cool by means of a flow of water, in order to prevent buckling during the bending operation. The first illustration shows a 5-in. standard pipe being bent to a 30-in. radius for use in a steam hammer supply line. Approximately two and one-half hours were required for one pipe fitter and helper to make this bend.

The details of the burner used are of particular interest. The burner body consists of a piece of standard pipe 1½ in. smaller in diameter than the inside of the pipe to be bent. In other words, for the best results, it is necessary to have a number of burners, one for each size of pipe. The standard pipe section which comprises the burner body is 6 in. long and blanked at each end by welding in a disc. Leaving a length of 1½ in. at the center of the original diameter, the ends are reduced ¼ in. in diameter to provide space for the necessary flow of air. Holes are drilled in the burner, as illustrated, being 3/16 in. in diameter and located 5/16 in. apart. Spacers, four in number, are welded in place to hold the burner central in the pipe. A pipe fitting is welded



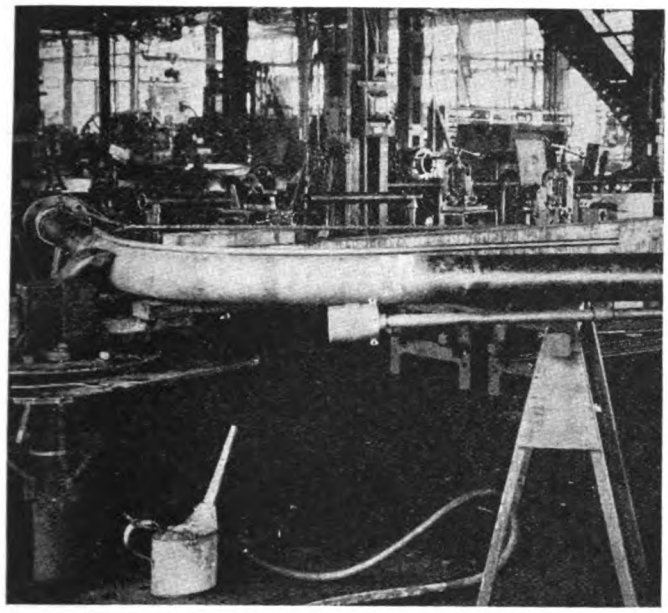
Details of the internal burner used in making large pipe bends



View showing the set-up for making a 30-in. radius bend in a piece of 5-in. standard pipe

on the end of the burner, providing a connection to the 1-in. supply pipe which also serves as a mixing chamber. This supply pipe is made in sections for greater convenience so that the length can be varied in accordance with the length of the large pipe to be bent.

The air supply is provided through a ¼-in. pipe from the shop air line with the pressure cut down to about 5 lb., as desired, by means of a square-head air cock. A shut-off valve is provided in the line just ahead of this air cock, which avoids the necessity of changing the



Close-up view of the large pipe bend with the burner removed to show its construction

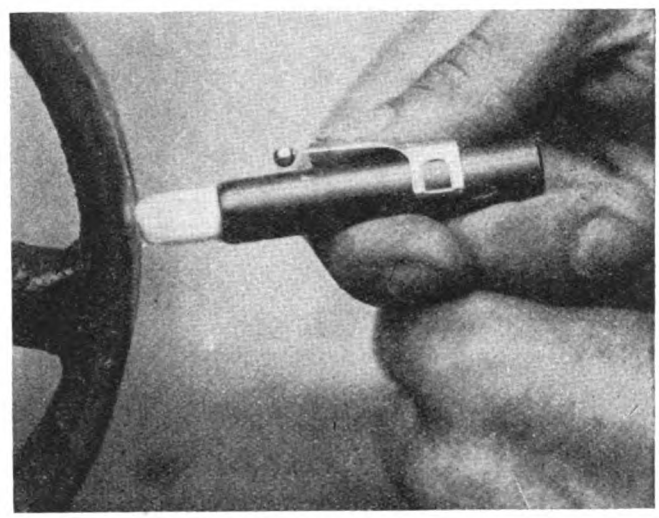
adjustment each time the burner is shut off or started. The same arrangement is used on the gas line, which utilizes artificial gas at a pressure of 3 ounces.

To give the necessary flexibility in handling the burner and attached pipes, the air-line connection is made of a 15-ft. length of ½-in. rubber hose, and the gas connection comprises a similar length of 1-in. water hose.

The advantage of this burner is its relatively inexpensive operation and the fact that heat is applied to the pipe exactly where needed and the pipe can be progressively heated just the right distance ahead of the point where the last partial bend was made. With a little practice, any competent pipe fitter can produce a smooth bend in large pipe at a minimum expenditure of time and labor.

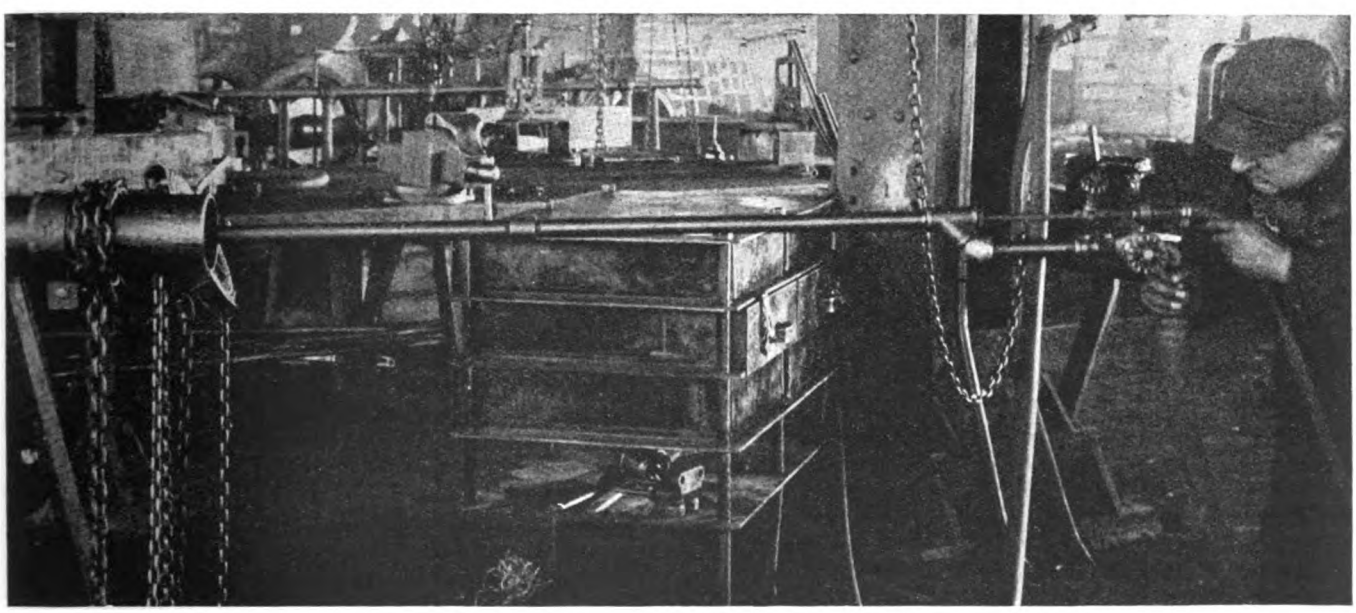
Holder for Centering Chalk

SOFT white crayon or stick chalk is, of course, the most practical for use about the lathe when setting and truing round work in the chuck. It does not usually last in one piece very long, however. Short pieces are not easy to handle and soon absorb grease and moisture from the fingers. Take an old fountain pen cap. With a bit of paper tighten a short piece of clean white chalk in it as shown. The fingers do no touch it and the



Centering-chalk holder

chalk is much easier to hold to a rapidly turning surface. Most of these caps have a pocket holder snap on them, or one can be easily attached. Keep the chalk point down in one of the handy breast pockets. It will always be convenient, clean and ready for use.

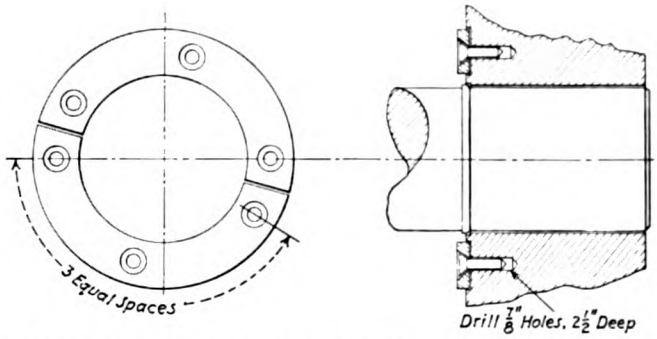


Operation of adjusting the internal burner as inserted in the pipe to be bent

Method of Applying Hub Plates

*By T. E. Paradise**

THE loosening up and dropping out of hub plates on drivers, trailers and engine trucks, cause a constant maintenance expense, due to removing the main driving and trailer truck wheels for their replacement; also, the renewal of driving-box faces, due to the cutting of these faces by the insecure fastenings of the hub plates. It is, therefore, important when applying hub plates that consideration be taken of the circular force exerted on their faces as this force is transferred to the fastenings. The face of the hub and the face of the hub plate coming in contact are both smooth and, therefore,

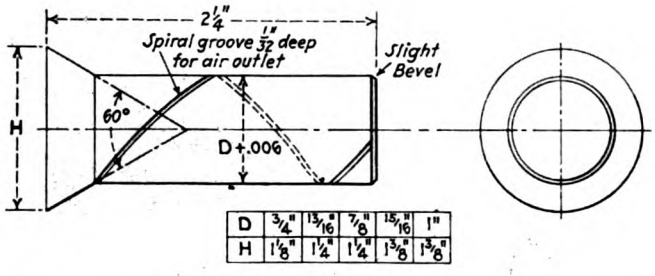


Method of holding hub plates securely in position by steel pins which are a drive fit in holes in the wheel center

cannot be relied upon to add any to the resisting force of the fastening which must be strong enough to keep the plate in position against the hub.

There are, at the present time, a great many methods used to hold hub plates in position. The following method gives good service and holds the hub plates in position against the hubs, preventing them from becoming loose, regardless of the service in which the locomotive is placed.

Referring to the illustration, the hub plate is turned to fit the counterbore in the wheel hub, as shown, and



Details of the mild-steel drive-fit pins used in applying hub wear plates

cut in two halves. It is then directly laid off from the hub by use of chalk applied to the hub hole, and lamp black on the hub face of the liner. The hub plate is then put in position and held, using a hammer to tap the exposed faces of the hub liner, thus marking the hub plate holes accurately. The holes are then drilled and countersunk with a tool that has a guide, making the countersink true with the drilled hole. It is important that the depth, diameter and taper of countersink be made to a gage.

Countersunk-head mild-steel pins are used as fastenings, with an allowance of .006 in. in diameter for a drive fit in the hub holes. These pins are manufactured on the turret lathe in standard sizes, and are kept in stock. They are not threaded, but depend upon the fit in the hub for holding the hub plate against the wheel face, also to hold the pins in. After these pins have been completed, before they are cut off in a turret lathe, a small circular groove is made, starting at the end approximately $\frac{1}{32}$ in. deep and $\frac{1}{32}$ in. wide, cut spirally around the pin with a $\frac{3}{4}$-in. lead. This groove is made on the pin to prevent the accumulation of air in the hub at the end of the pin as it is being driven in.

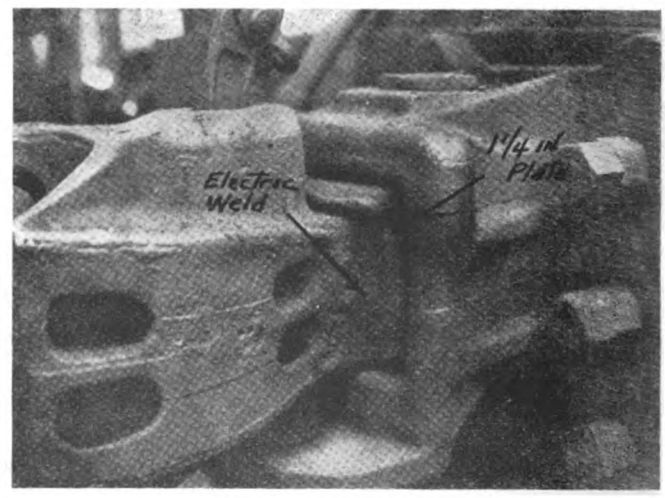
To apply the hub plate, it is necessary to place the hub plate in position, and drive the plugs in with a sledge hammer and punch, or with an air hammer. An air hammer does the work very well, the pins being driven in until they are solid, drawing the hub plate against the hub. The heads of these pins should be at least $\frac{1}{8}$ in. below the wearing surface of the hub plate. There should not be any riveting or chipping on these pins after they are driven in, as they should be made the proper length and have heads of the proper thickness. With this method of application, it is practically impossible for the hub plates to loosen up regardless of the friction on the faces.

Hub plates applied in the manner described will avoid the necessity of wheels being dropped for their renewal or any other reason, except excessive lateral.

* Master mechanic, Chicago, Burlington & Quincy, Alliance, Neb.

Reducing Lateral In Front-End Couplers

ONE railroad was experiencing a large number of derailments of cabooses when helper engines were used to help trains over grades. It developed that the cabooses were derailed after coming out of a curve onto



Reduced lateral in front coupler pockets prevented derailments caused by pusher locomotives

the straight track. In many cases the cause of the accident was attributed to the superstructure of the caboose being out of line or excessive end play in the journal bearings. A special inspector who was assigned to ride several of the cabooses while the helper engines were

coupled to them developed that the trouble was caused by excessive lateral between the side walls of the front-end or "bull-nose" casting and the side of the coupler stem together with the coupler pin hole being somewhat elongated in the front couplers of the helper engines.

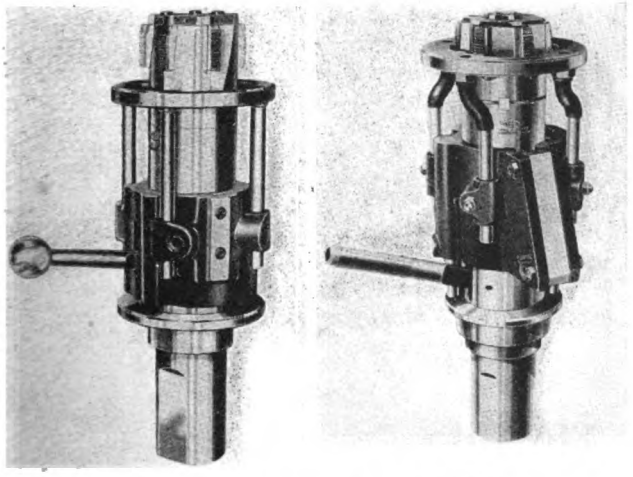
To overcome this condition instructions were issued for examination and rebushing of the coupler pin holes found worn in all front-end couplers at each form period. Also a 1¼-in. bar-iron plate was electrically welded to each side of the couplers on all helper engines as shown in the accompanying illustration. This reduced the lateral to one inch on each side of the coupler stem and has eliminated the derailments.

Due to the elongated condition of the coupler pin hole, when the engine was rounding a curve the coupler would move over to one side of the coupler casting and lock preventing it from straightening when straight track was reached.

Collapsible Taps for Straight and Taper Threads

THE Landis Machine Company, Waynesboro, Pa., has developed a new line of collapsible taps to supersede the Victor collapsible taps formerly manufactured by the Victor plant of this company. These new taps are made in two types—the Landis style LT, a collapsible tap for either straight or taper tappings, and the Landis style LM receding-chaser collapsible tap for taper tapping. They can be used either as stationary or rotary taps.

The outstanding feature of the new taps is a design whereby the tap consists of two units, a tap body containing the operating mechanisms and a tap head in which the chasers are supported. This arrangement offers many advantages since it permits the use of one tap body to cover a wide diametrical range by the application of tap heads of various sizes. In addition, the same tap body may be used for either right- or left-hand tapping, provided right- and left-hand tap heads are employed.



Landis collapsible taps, types LT and LM, for straight and taper threads

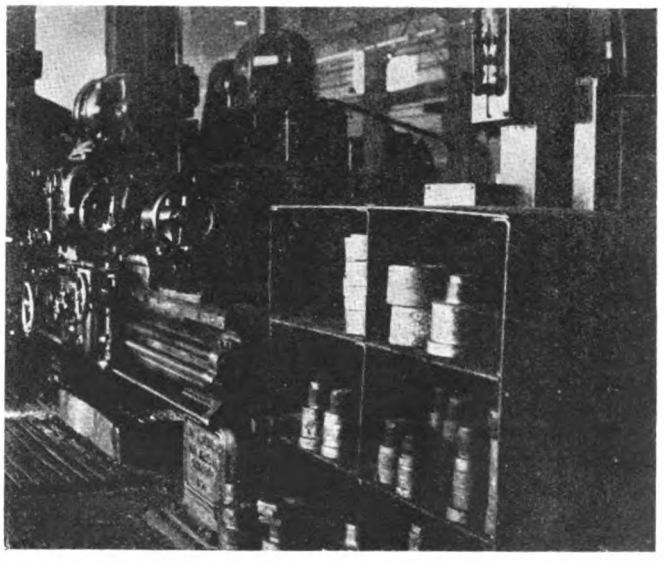
The collapsing mechanism is positive in its action, both with respect to locking the chasers in cutting position and in its collapsing action. The collapsing action is obtained through a hardened steel trip ring coming in contact with the part being tapped, thus insuring uniform thread length. The trip ring is adjustable for various thread lengths. The tap heads are adjustable for size by an adjusting screw located in the front end of the plunger. The screw is self-locking and is of the ratchet type so that a turn of the screw of one notch gives an adjustment to the chasers amounting to exactly 0.001 in.

The chasers are supported in slots in the tap head and are held securely in tapered seats in a hardened and ground plunger. The design of the plunger is such as to provide maximum rigidity for the chasers and at the same time there is no tendency for the plunger to rotate under cutting strains and thereby force the chasers out of alinement. All locating surfaces of the chasers, as well as the thread form itself, are precision ground.

Style LT collapsible taps are designed primarily for straight tapping, but can be used successfully for tapping tapered threads of a length not exceeding the American tapered pipe standards. Style LT taps are made in five sizes which, when equipped with the proper tap heads, cover a combined range from 1¼ in. to 13¼ in. inclusive. Style LM receding-chaser collapsible taps are designed for tapping tapered threads. The receding chaser action minimizes cutting strains on this class of work, with the result that greater accuracy and longer chaser life is obtained. Style LM taps are also made in five sizes covering a combined range from 1¼-in. to 12-in. pipe or 1½-in. to 13⅜-in. diameter.

Stationary Material Bins At Lathes

TO eliminate the necessity for lathe operators to leave their lathes or to run out of work at any time during their tour of duty a stationary material bin was installed at each lathe in a back shop. Various types of knuckle pins that require turning or bushings are delivered to the bins by material distributors at the direction of the machine-shop or general foreman and instructions are issued each day to the lathe operator as to the items he must turn out. After the material is completed by the lathe operator it is placed in the fin-



Bins for finished and unfinished work at the lathe

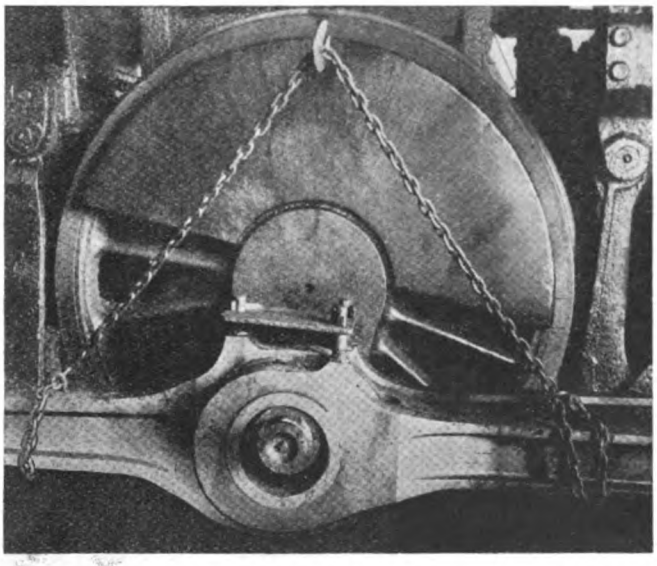
ished side of the bin and is collected by material distributors daily.

The bins are made from ¼-in. sheet steel, either riveted or welded together as shown in the accompanying illustration, and are of the size required for the various types of work which they are to contain.

This system not only eliminates the necessity for the lathe operator to leave his lathe but affords the shop foreman an opportunity of frequently inspecting the work turned out by each operator.

Tandem Main-Rod Lifting Device

A SOMEWHAT awkward operation in handling modern locomotive main rods of the tandem type is greatly facilitated by means of the device shown in the illustration. This device, which was developed at the Chicago shops of the Chicago & North Western and is now used quite extensively at other shop and enginehouse points on this road, consists of a ⅝-in. steel plate, 16 in. long by 12 in. wide, drilled with three holes, corresponding in position to the grease plug holes, in the tandem main rod. Suitable plugs, firmly screwed



Tandem main-rod handling device used on the C. & N. W.

into the grease plug holes, are provided with extensions on the upper ends which pass through the holes in the steel plate. The plate is then held tight by means of keys, as illustrated, or, in some cases, by threaded bolt and nut connections.

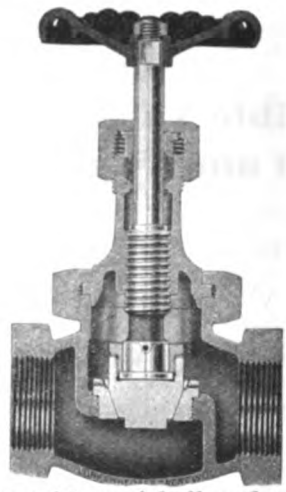
Since the two parts of the tandem main rod swivels on a steel bushing, it is obvious that the use of this plate to hold the grease plug holes in a fixed relationship will have the effect of holding both parts of the tandem main rod in practically a horizontal position, the rod then being handled easily and safely by means of the usual chain and hoist connections. The merits of this device will be readily appreciated by all shop or enginehouse men who have attempted to handle the heavy tandem main rods, which, without some such provision, have a tendency to "jack-knife" at the slightest provocation with consequent difficulty and, sometimes, danger in handling.

Plug-Type Renewable-Seat Valves

FOR severe service demanding maximum resistance to destructive action on valve-seat bearings the Lunkenheimer Company, Cincinnati, Ohio, has developed a new line of valves with plug-type NS5 alloy seats and discs which are known by the trade names Renewo and Ferrenewo.

NS5 alloy is a new and exclusive Lunkenheimer development which is said to be a non-galling, non-ferrous composition of great hardness (300 Brinell), resistant to wear, abrasion, erosion and corrosion, and retains its hardness at high temperatures.

These plug-type valves are made with full length,



Valves with special alloy plug and valve seat

deep-seated plugs. Each plug is ground into its own seat to a uniform bearing from end to end, thus insuring a leak-proof fit. Iron-body bronze-mounted Ferrenewo plug-type valves are made for 150-lb. steam pressure, while the bronze Renewo valves are available in both 200 and 300-lb. steam pressure patterns. Excepting bodies and bonnet rings, all parts of Ferrenewo and medium Renewo valves are interchangeable; hence, it is necessary to carry but one stock of parts for both valves. This interchangeability feature likewise applies to the various patterns of extra-heavy Renewo valves.

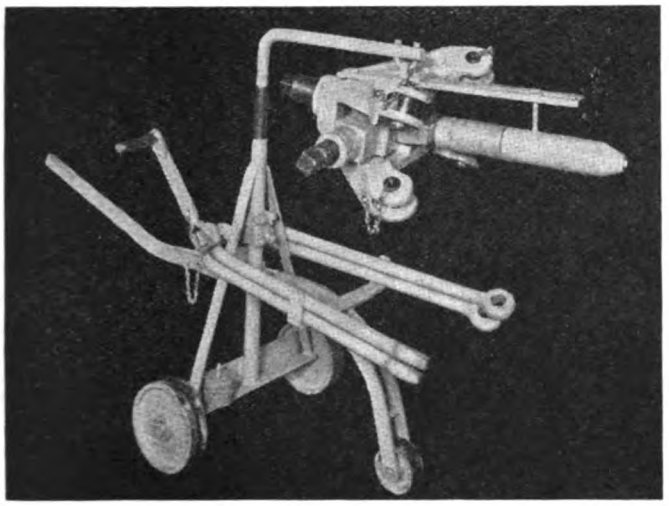
Flexible Piston Parter

SEVERAL improvements and refinements have been incorporated recently in the design of the flexible piston parter made by Smith Devices, Philadelphia, Pa. The object of this device is the quick and easy separation of the locomotive piston rod from the crosshead without exertion of undue effort and with assurance against damage to either piston rod or crosshead. One of the illustrations shows the device as attached to the crosshead and the other the device ready for transportation to the locomotive. The one attached to the crosshead is of a somewhat older design than the one shown alone. By means of a light three-wheel goose-neck truck one man can easily move the device from the toolroom to the place where it is to be used. As will be noted the truck

carries all parts required, so that only one trip is necessary. The power portion is suspended on an arm which can be raised and lowered by the operating wrench to suit the crosshead height. Detachable U-bolts, which take the strain, are connected to the parter by pins and bear against the front of the crosshead boss above and below the piston-rod fit. By this arrangement no strains are placed on the body of the crosshead to damage it in any way.

After the U-bolts are in place the slack is taken up by a large central saddle screw. The parting of the rod is then effected by the power or jacking device. This consists of a wedge, mounted between rollers, moved in and out by the detachable crank arm, and exerts a pressure on the plunger which bears against the end of the piston rod. By means of this device it is said that with a 20-in. leverage a pressure as high as 100 tons can be exerted. The flexible piston parter, which is made of alloy steel, heat treated, is available in two sizes. The No. 1 size handles all rods from the smallest to the largest, while the No. 2 size handles up to crossheads with a 4-in piston rod.

A similar device, equipped with four hooks, makes a very convenient tool for pulling pinions and gears, pulleys, etc. Such pullers or strongbacks are available in several sizes.



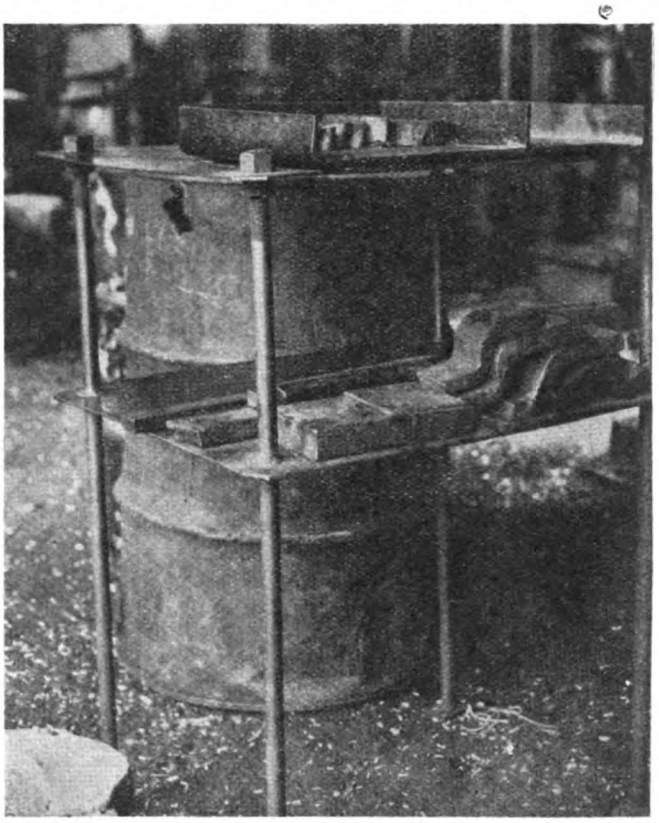
Improved Smith flexible piston parter



Smith piston parter set up and attached to locomotive crosshead

A Tool Tray For the Machine Shop

AT every lathe or machine in the machine shop there are numerous tools that must be kept on hand for use when needed. Unless some arrangement is provided for the machine operator to store these tools in a convenient place where they can be easily selected when required he is apt to store them under the machine, on shelves in the wall of the shop or keep them in his locker where they cannot be periodically inspected by himself or the foreman.



One side of the two-part tray is for good tools; the other is for tools needing grinding

In addition to providing a stand for each machine operator one foreman arranged a tray to be kept on top of the stand for storing cutting tools. One side of the tray is painted red, in which the tools requiring dressing are placed by the operator and the other side is painted black, in which side the serviceable tools are kept.

Tools that require dressing are collected several times each day and dressed by a competent mechanic after which they are re-distributed to the various lathes or machines.

Among the Clubs and Associations

CANADIAN RAILWAY CLUB.—A. I. Lipetz, consulting engineer, American Locomotive Company, presented a paper on Recent Progress in the Development of the Steam Locomotive at the April 9 meeting of the Canadian Railway Club.

NEW ENGLAND RAILROAD CLUB.—A review of railway rolling stock, locomotives, passenger cars and freight-train cars, outlining the progress of their development and studying the relation of modern equipment types to the needs of the service, was presented at the April 10 meeting of the New England Railroad Club by L. K. Sillcox, vice-president, New York Air Brake Company.

CENTRAL RAILWAY CLUB OF BUFFALO.—Three papers were presented at the April 12 meeting of the Central Railway Club of Buffalo, also a special feature, "The Forgotten and the Known Railroad Men in Passenger Operation," which was presented by the male chorus of the club. The papers were: Air Conditioning of Passenger Cars, by Col. George H. Emerson, chief of motive power and equipment, Baltimore & Ohio; A Modern Ticket Office, by C. A. Thurber, city passenger agent, Lehigh Valley, and The Public's Viewpoint on Railroad Passenger Operation, by Maj. H. Morton Jones, vice-president and treasurer, R. T. Jones Lumber Company.

WESTERN RAILWAY CLUB.—Meeting held Monday evening, March 19, at the Hotel Sherman, Chicago. Subject "Air Conditioning of Passenger Cars," by A. R. Walker, electrical engineer of equipment, Illinois Central. ¶ This paper, which contained a considerable amount of information not previously published regarding air-conditioned passenger cars, was largely devoted to a discussion of factors involved in specifying air-conditioning equipment to meet particular operating requirements. After outlining the general principles of operation on the various methods of air-cooling, including ice, steam-ejector, electro-mechanical, and direct-mechanical, Mr. Walker stated that each system has its advantages and disadvantages and that, in order to make intelligent recommendations, it is necessary to develop all the facts regarding each proposed installation and decide which system will be the most economical and give the best results He called attention to the necessity for adequate power supply and said that, in addition to the electrical load, steam systems require approximately 270 lb. of steam per hour, whereas direct-mechanical systems impose an additional load of approximately 10 kw. per car, all of this power being supplied by the locomotive en route. ¶ The cost of supplying this power was calculated by Mr. Walker to be $.01888 per 100 lb. of steam and $.00833 per kw. hr. Using these figures and an average cost of $4 per ton for ice, Mr. Walker made an interesting comparison of the cost per hour of electric power, steam and ice for a 6-ton-capacity refrigerator system, as follows: Direct-mechanical system, $.08330; steam-ejector system, $.08015; ice system, $1.00833. In another comparison of a specific run of 294.3 miles, the power requirements and cost per car, assuming that cooling was required only 75 per cent of the time, were calculated for the three systems mentioned to be $.44, $.41 and $4.92, respectively. ¶ Mr. Walker stated that operating cost is not the only important consideration and that such items as generator capacity, weight, pre-cooling, reliability, maintenance, interchangeability and fixed charges must be given due weight. Mr. Walker concluded his paper as follows: "It might be well to point out that air-conditioning has been developed during a time when the railroads were less able than at any time in their history to finance any new development. There is no question as to the desirability or even the necessity for air conditioning, and the only thing that remains is to determine the most economical and satisfactory method, all factors considered."

Directory

The following list gives names of Secretaries, dates of next regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 2205, 150 Broadway, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—Division V.—MECHANICAL.—V. R. Hawthorn, 59 East Van Buren street, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorn, Chicago.

DIVISION VI.—PURCHASE AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Columet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, Room 332, 30 Church street, New York. Spring meeting, Denver, Colo., June 25-28.

MACHINE SHOP PRACTICE DIVISION.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—Edgar J. Kates, 1350 Broadway, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, La Salle Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth street, Council Bluffs, Iowa. Regular meetings, second Tuesday of each month at Council Bluffs.

CENTRAL RAILWAY CLUB OF BUFFALO.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month except June, July and August, at Hotel Statler, Buffalo.

CLEVELAND RAILWAY CLUB.—F. B. Frericks, 14416 Alder avenue, Cleveland, Ohio. Meetings temporarily suspended.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. I Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon, 12:15 p. m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha street, Winona, Minn.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN.—C. L. Roberts, R. F. D. 5, Peoria, Ill.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md. Annual meeting October 17-18, Hotel Stevens, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver buiding, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TORONTO RAILWAY CLUB.—N. A. Walford, district supervisor car service, Canadian National, Toronto, Ont. Meetings first Friday of each month except June, July and August.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—C. L. Emerson, 822 Straus Building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

NEWS

THE DONNER-HANNA COKE CORPORATION has awarded a contract to the Pressed Steel Car Company for the rebuilding of 100 hopper cars of 70 tons capacity.

THE WESTERN MARYLAND has ordered 10 loco valve pilots from the Valve Pilot Corporation, New York. The ERIE recently placed an order with the same company for two valve pilots.

THE GREAT WESTERN ELECTRO-CHEMICAL COMPANY has ordered two class 105 tank cars of 30,000 lb. capacity from the General American Tank Car Corporation. These cars are to be used for the transportation of liquid chlorine.

THE ERIE has ordered eight all-steel combination passenger, baggage and mail cars from the American Car & Foundry Company. Inquiry for this equipment was reported in the March issue. Inquiry is being made for 50 bulk cement cars of 50 tons' capacity.

THE NORTHERN PACIFIC has placed an order with the Timken Roller Bearing Company, Canton, Ohio, for Timken bearings to be used on all axles, including driving axles, on 10 large class 4-8-4 high speed passenger locomotives recently ordered from the Baldwin Locomotive Works.

THE MISSOURI-KANSAS-TEXAS has just completed four new diners completely equipped with kitchen and pantry equipment of Enduro stainless steel, a product of the Republic Steel Corporation, Central Alloy division, Massillon, Ohio. The equipment was fabricated and installed by the M-K-T forces at the passenger car shops, Sedalia, Mo. Present plans call for four more diners of this type. In addition to these diners, three de luxe club cars with soda fountains and back bars of Enduro stainless steel are in service on M-K-T lines.

George H. Houston Heads Capital Goods Committee

AT THE GENERAL CONFERENCE of code authorities and code committees representing the various industries with the National Recovery Administration at Washington, called for the purpose of revising the various codes with a view to creating more employment, George H. Houston, president of the Baldwin Locomotive Works, was designated by Administrator Johnson as chairman of a committee representing the capital goods industries to present the views of those industries as to the general problem. Another committee was appointed to represent the consumer goods industries and both held conferences with General Johnson on March 8, after which they remained in Washington for further conferences. In addresses before the general conference both President Roosevelt and General Johnson urged the representatives of industry to adopt a plan for shortening hours of labor and increasing wages and General Johnson suggested a plan for a general 10 per cent reduction in hours and increase in wage rates. It was recognized that a uniform plan could not be applied for all industries and the efforts of the N. R. A. seemed to be exerted toward voluntary proposals from the industries.

Mr. Houston acted as chairman of a meeting at which a committee of fifteen



George H. Houston

was appointed and after the conference with Johnson issued the following statement of its general attitude:

"The solution of unemployment in the durable goods industries cannot be accomplished by a reduction of hours and increase of wages, inevitably followed by increased cost, with business volume so drastically reduced at this time," the statement said. "Purchase of durable goods diminishes rapidly with increasing price. Further curtailed demand for durable goods at this time would freeze unemployment now existing in this field for the indefinite future. Flexibility in hours of work as is possible under the codes is essential to the operation of the durable goods industry. This can only be accomplished in the face of conditions that will give security of principal and such rate of return as will encourage men to take the hazard of investment. The primary concern must be to restore those conditions that will cause the owners of capital to risk it in private enterprise and private enterprise again to undertake new ventures. To accomplish such a step, the amendment of the Securities Act of 1933 is necessary, as well as the rewriting of the proposed National Securities Exchange Act of 1934, so as to encourage the issuance and free exchange of industrial securities under reasonable and proper regulation without restriction of the capital needs of business."

Northern Pacific to Enlarge Enginehouses

PLANS ARE being made by the Northern Pacific for the expenditure of about $245,000 during the next few months for the enlarging of enginehouses and the strengthening of bridges on certain parts of its lines to permit these structures to accommodate 4-8-4 type locomotives, having a length of about 110 ft., of which 10 are now under construction for this company.

The program will involve the following work at enginehouses: St. Paul, extend five stalls to 130 ft., $30,000; Jamestown, extend four stalls to 135 ft., $25,000; Missoula, extend six stalls to 135 ft., $30,000; Parkwater (Spokane, Wash.), extend one stall to 130 ft., $5,000; Seattle, extend five stalls to 130 ft., and replace 85 ft. turntable with 115-ft. three-point support turntable, $75,000.

Railway Car Appliance Industry Organized for Code

IN ORDER to carry out the N. R. A. code of the railway car appliances industries, these companies have organized as the Railway Car Appliances Association, a division of the Fabricated Metals Products Manufacturing and Metal Finishing and Metal Coating Industries.

Officers are as follows: President, W.

Progress in Air-Conditioning Programs During Recent Weeks

Road	No. of cars	Type of car	Type of system	Builder
B. & O.	42	Pullman	Mech.	.....
	16	Coaches		
	41	Dining-lounge		
B. & M.	10	Coaches	Inquiries are being made for this equipment	
	10	Diners		
C. & N. W.	2	Lounge	Mech.	Melcher
C. M. St. P. & P.	22	Pass.	.....	To be installed in company shops
D. L. & W.	6	Diners	Ice	Safety Car Htg. & Ltg. Co.
	2	Buffet		
	1	Club		
	7	Pull. sleep.	Ice	.....
	7	Pull. parlor		
N. Y. N. H. & H.	57*	de luxe coaches	Freon	Safety Car Htg. & Ltg. Co.
	12*	Comb. de luxe coaches and baggage cars		
Sou. Pac.	6	Pull. club	Mech.	.....
	12	Pull. observa.		
	22	Pull. room		
	5	Diners	Mech.	P. C. & M. C.
	5	Diners	Ice	To be installed by road
	4	Observa.		
	7	Lounge		
	4	Club		
	2	Parlor		

*All of these cars will derive the necessary power for air-conditioning and lighting from 15-kw. safety generator equipments, using Dayton-Roderwald, cogbelt and gear, axle drives.

E. Sharp, president of the Grip Nut Company, Chicago; treasurer, Arthur A. Frank, vice-president of the Union Metals Products Company, Chicago; temporary secretary, William H. Winslow, Jr., an attorney; directors, in addition to Mr. Sharp and Mr. Frank, include, A. C. Moore, president, Chicago Railway Equipment Company, Chicago; W. D. Thompson, president, Hutchins Car Roofing Company, Detroit, Mich.; A. D. Bruce, vice-president and secretary, Vapor Car Heating & Lighting Company, Inc., Chicago; W. W. Darrow, vice-president, Camel Sales Company, Chicago; C. D. Jenks, president, Chicago Cleveland Car Roofing Company, Chicago; G. N. DeGuire, assistant to the president, Locomotive Firebox Company, New York; and J. P. McWilliams, president, Youngstown Steel Door Company, Cleveland, Ohio. The Code committee consists of Mr. Sharp, Mr. Moore and Mr. Thompson.

Members of the association are as follows: Ajax Hand Brake Company, Chicago Cleveland Car Roofing Company, Camel Sales Company, Chicago Railway Equipment Company, O. C. Duryea Corporation, Evans Products Company, Enterprise Railway Equipment Company, Grip Nut Company, Gustin-Bacon Manufacturing Company, Gold Car Heating & Lighting Company, Hutchins Car Roofing Company, Illinois Railway Equipment Company, W. H. Miner Company, P. H. Murphy Company, Railway Metal Products Company, Roth Manufacturing Company, Standard Car Truck Company, Standard Railway Equipment Company, Safety Car Heating & Lighting Company, Union Metal Products Company, Union Railway Equipment Company, Vapor Car Heating & Lighting Company, Inc., Western Railway Equipment Company, Youngstown Steel Door Company, Railway Devices Company, Camel Company and Lumber Products Company.

Orders for Locomotive Firebox Company's Syphons

THE LOCOMOTIVE FIREBOX COMPANY has received orders for 40 Nicholson thermic syphons for fifteen 2-8-4 freight locomotives and five 0-8-0 switching locomotives now under construction for the New York, Chicago & St. Louis. Two syphons will be applied to each firebox. Orders for eight syphons received from England have added two new foreign railroads to the list of syphon users outside of the United States. Two syphons are to be installed in each of three XD class locomotives being built by the Vulcan Foundry, Ltd., for the South Indian Railways. One set of two syphons has been ordered for the Peruvian Corporation. All of these syphons will be manufactured in England by Beyer, Peacock and Company. Inquiries have been received from the Peiping Liaoning Railway in China for two sets of two syphons. The Lehigh Valley has inquired for five sets of three firebox and one combustion chamber syphons and the Delaware, Lackawanna & Western for 20 sets of two firebox and one combustion chamber syphons. The Chicago, Milwaukee, St. Paul & Pacific has inquired for 30 sets of two firebox and one combustion chamber syphons. All of these inquiries are in connection with proposed new 4-8-4 type locomotives.

P. W. A. Loans

DURING the past month the following progress has been made in P. W. A. negotiations:

Baltimore & Ohio.—A contract for a loan of $4,500,000 has been signed which will enable the B. & O. to spend $5,484,406 this year in giving additional employment to its track and shop forces and purchasing materials, including 49,000 tons of rails and fastenings; the construction of 820 fifty-ton steel gondola cars, at an estimated cost of $1,145,244, heavy repairs to 4,800 freight cars, $1,923,000; reconstruction of 200 automobile box cars, $134,000; and reconditioning 240 locomotives, $1,078,000. $984,406 of the $5,484,406 is funds of the B. & O.

Boston & Maine.—A contract has been signed covering a loan of $2,230,000 for rails and fastenings and a contract for a loan of $2,628,000 for new equipment is in the course of preparation. Details concerning the equipment to be purchased are given in the March issue. Inquiry is being made for the de luxe seats in 10 passenger coaches and for air-conditioning equipment for four dining cars.

Central of Georgia.—The allotment to the C. of Ga. has been increased from $500,000 to $600,000 for 200 70-ton coal cars instead of 50-ton cars.

Chicago Great Western.—An allotment of $1,200,000 has been made for the purchase of 500 box cars.

Chicago, Milwaukee, St. Paul & Pacific.—A contract has been signed covering a loan of $2,317,000, of which $136,000 will be used to install air-conditioning equipment in 22 passenger coaches and $114,531 to equip 300 automobile cars with patented loading devices. The remainder of the $2,317,000 will be spent for rail and fastenings. A contract for $1,716,000 for building the 75 new passenger-train cars listed in the March issue has also been signed.

Delaware, Lackawanna & Western.—In its report approving the proposed expenditure by the D. L. & W. of $4,666,000 for the purchase and reconstruction of equipment the Interstate Commerce Commission stated that a protest had been received from a vice-president of the Brotherhood of Locomotive Firemen and Enginemen against "approval of a loan" for the purchase of five oil-electric locomotives on the ground that the company's steam locomotives were adequate for its service and that the installation of the oil-electric locomotives would result in the furlough of firemen and engineers. The commission stated, however, that this raised a question bearing on the propriety of making the loan, which was not for its determination, and that its function was only to determine the desirability of the change in motive power as an improvement of transportation facilities.

Erie.—A contract has been signed for a loan of $2,671,000 to be used to purchase rail and fastenings and rebuild 750 freight cars. $623,000 will be spent for converting the 750 cars from drop-bottom gondolas into self-clearing hopper cars in the company's shops at Dunmore, Pa. This is the second loan contract with the Erie to be signed by Administrator Ickes, the first covering a loan of $11,282,000 for purchasing 3,775 new freight cars and 133 new passenger train cars.

Fort Smith & Western.—An allotment of $75,000 has been made to the receiver of this road for repairs to 170 freight cars and track and road work.

Great Northern.—A contract for an allotment of $4,935,000 to this road has been signed. Of this amount $669,500 will be used for classified repairs to 316 locomotives; $674,000 for repairing 6,374 freight cars; $484,000 for reconditioning and rebuilding 138 passenger cars, including air-conditioning of 6 dining cars. The remainder of the allotment will be used for the renewal or improvement of bridges and buildings, work on right-of-way, etc.

Gulf, Mobile & Northern.—I. C. C. approval has been asked for the expenditure of $1,000,000 by this road for the purchase of 150 box cars, 50 gondolas, 4 motor cars with 600-hp. Diesel engines, 2 passenger coaches and 2 observation sleeping cars.

Midland Continental.—This road, which was allotted a loan of $40,000 to be used in the purchase of a Diesel-electric locomotive, has applied to the Interstate Commerce Commission for an amended authorization of the proposed expenditure to permit it to purchase such a locomotive from the Westinghouse Electric & Manufacturing Company at a cost of $52,000, in place of one on which it had received bids.

Illinois Central.—The I. C. C. certificate to the Illinois Central has been modified so as to approve of a change in plans. Instead of using $65,000 for ties and $183,100 for labor for applying new material and surfacing track the company proposes to purchase 248,100 ties at $1 each and instead of $6,210,555 for repairs to freight cars it proposes to spend only $5,210,555 for this purpose and to make repairs to locomotives at a cost of $1,000,000.

Lehigh Valley.—Two payments totaling $888,000 have been made on the loan of $2,000,000 to this road reported in the January issue. The five new locomotives, for which a loan of $600,000 was reported in the March issue, are to be built by the Baldwin Locomotive Works. The original request for these locomotives was for $500,000.

New York, New Haven & Hartford.—The New Haven has applied to the I. C. C. for approval of the expenditure of its allotment of $2,300,000 for the purchase of 50 passenger coaches, 2 steel passenger trailers, and 2 car units equipped with Diesel-electric motive power. An order for 50 passenger cars has been placed with the Pullman-Bradley Car Corporation. An additional $300,000 has been allotted for a four-car, high-speed streamlined train, including two cars with Diesel motors.

Pennsylvania.—Checks totaling $17,379,000 have now been sent to this road, in the following amounts: $6,990,000; $9,760,000 and $629,000.

Pittsburgh & West Virginia.—The loan of $331,000, for which a contract has now been signed, will be used for the purchase of three 2-6-6-4 Mallet type locomotives under construction by the Baldwin Locomotive Works.

Savannah & Atlanta.—An allotment of $250,000 to the receiver of this road will be used for the purchase of 100 new box cars.

Seaboard Air Line.—The receivers of the Seaboard Air Line have applied for a loan of $3,000,000 to $3,500,000 and have applied to the Interstate Commerce Commission for authority for the expenditure for the purchase of 5 locomotives, 1,000 fifty-ton steel box cars, and 100 phosphate cars. Inquiries have been placed for the box cars and for five 2-6-6-4 Mallet type locomotives.

Among the roads applying for or receiving allotments for the purchase of rail, track fastenings, etc., are the Grand Trunk Western, $250,000; Great Northern, $1,305,000; Kansas, Oklahoma & Gulf, $255,000; Main Central, $313,000; New York Central, $400,000; New York, Ontario & Western, $235,000. The N. Y. C. will apply for a further loan of approximately $2,200,000 for rail purchases and work incident thereto.

Supply Trade Notes

HAROLD S. RUSSELL, 332 South Michigan avenue, Chicago, has been appointed representative for the Schaefer Equipment Company, Pittsburgh, Pa.

JOSEPH SINKLER, INC., 122 South Michigan avenue, Chicago, has been organized by Joseph Sinkler, formerly general manager of the Pilot Packing Company, Inc., to sell railway supplies.

J. CLAY LEE, assistant manager of the railway sales division of the Standard Oil Company of Indiana, has been appointed manager of the division with headquarters at Chicago.

RALPH G. CAULLEY has joined the Detroit, Mich., district sales office of Republic Steel Corporation, Youngstown, Ohio. Mr. Caulley had been connected with the Wheeling Steel Corporation for 14 years, the last seven of which were spent in the Detroit district.

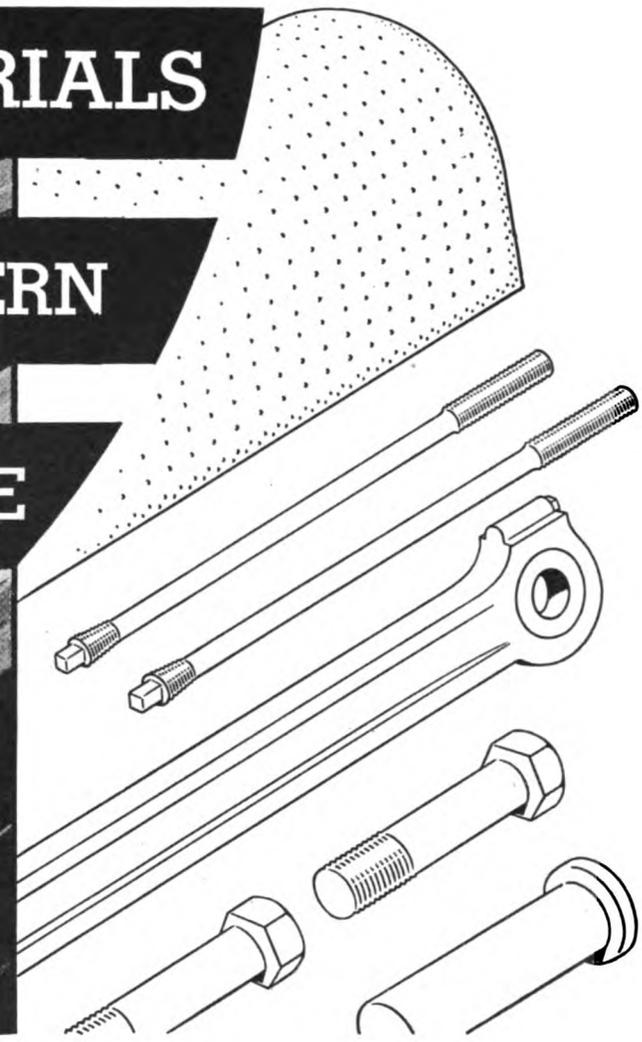
AHRENS & RICHARDSON, 30 Church street, New York, in addition to other accounts, have been given exclusive charge of sales in the eastern territory for the Foster-Johnson Reamer Company, Elkhart, Ind., handling a full line of reamers for air-brake maintenance and repairs.

THE ROSS AND WHITE COMPANY, Chicago, has concluded a contract agreement with the owners of the patents for the railroad rights in locomotive coaling plants of the Adams withdrawal and mixing chute. This chute is designed to mix large and

(Turn to next left-hand page)

MODERN MATERIALS .... MAKE MODERN DESIGNS POSSIBLE





Lightweight, stream-lined equipment has focused attention on the importance of new and improved materials in modern railroading. • • • Less spectacular but equally important has been the influence of improved materials on standard equipment. • • • Cars have had their life prolonged by repairing with corrosion-resisting Toncan Iron sheets. • • • Fireboxes have been given the protection of special alloy irons and steels, resulting in longer service between shoppings. • • • Staybolts have greater fatigue resistance, thanks to Agathon Nickel Iron. Non-stretching Agathon engine bolt steel has also kept equipment out of the shop. • • • These are only a few examples of the many special materials developed by Republic metallurgists to help the railroads attain greater reliability of performance and lower maintenance costs. • • • Consult Republic on your materials problems.

Toncan Iron **Boiler Tubes, Pipe,** Plates, Culverts, Rivets, **Tender Plates** and Firebox Sheets • **Sheets and Strip** for special railroad purposes • **Agathon Alloy Steels** for **Locomotive Parts** • **Agathon Engine** Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, **Maney Guard Rail Assemblies** • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel

The Birdsboro Steel Foundry & Machine Company of Birdsboro, Pa. has manufactured and is prepared to supply under license, Toncan Copper Molybdenum Iron castings for locomotives.

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

AGATHON NICKEL IRON

REPUBLIC STEEL CORPORATION

GENERAL OFFICES YOUNGSTOWN, OHIO

REG. U.S. PAT. OFF. TONCAN COPPER MOLYBDENUM IRON

fine coals in passing to locomotive tenders. The Ross and White Company also secured railway sales rights for the Blackhall railroad car washing machine.

W. M. STEVENSON, for the past four years district representative of the Crucible Steel Company of America, at Rockford, Ill., has been transferred to the railway department of that company, with headquarters at 1258 East Fifty-fifth street, Cleveland, Ohio.

THE SAFETY CAR HEATING & LIGHTING COMPANY will move its executive offices about April 14 from 75 West Street to 230 Park avenue, New York City. Arthur B. Mills, sales representative of the Safety Car Heating & Lighting Company at Boston, Mass., has been appointed manager of the New England sales district with headquarters as heretofore at Boston.

THE RUSSELL, BURDSALL & WARD BOLT & NUT COMPANY, Port Chester, N. Y., has acquired from the American Marsden Company, Jersey City, N. J., the sole manufacturing and sales rights in the United States of the Marsden locknut. A Marsden locknut division has been created at Port Chester. C. E. S. Place, formerly chief engineer of the Marsden Company, now is associated with Russell, Burdsall & Ward in this connection.

THE LOCAL INTERESTS of the Pacific Car & Foundry Company, Seattle, Wash., have acquired the stock control formerly held by the American Car & Foundry Company in that company. Officers of the re-organized company are now as follows: Paul Pigott, president; H. N. Curd, vice-president and general manager; William Pigott, vice-president and treasurer and W. S. Bassage, secretary and assistant treasurer.

C. L. SHEEN, district sales manager of the American Locomotive Company and the Railway Steel-Spring Company at San Francisco, Cal., has been promoted to a position in the St. Louis, Mo., office. Mr. Sheen has been connected with the American Locomotive Company in various positions for the past 14 years and for the past seven years has been located on the Pacific coast Marshall D. Raymond has been appointed district sales manager of the American Locomotive Company and the Railway Steel-Spring Company in San Francisco. Mr. Raymond was previously connected with the New York and St. Louis offices.

WILLIAM H. WINTERROWD, vice-president of the Lima Locomotive Works, Inc., has resigned to become a vice-president of the Franklin Railway Supply Company, assuming the duties heretofore carried on by vice-president J. L. Randolph, who has resigned. Mr. Winterrowd's headquarters will be in Chicago. Mr. Winterrowd was born April 2, 1884, at Hope, Ind. He attended the high school at Shelbyville, Ind., and was graduated from Purdue University in 1907. During his summer college vacations he worked as a locomotive wiper on the Missouri Pacific, blacksmith helper on the Lake Erie & Western (now the New York, Chicago & St. Louis) at Lima, Ohio, and as a car and air brake repairman on the Pennsylvania, Lines West of Pittsburgh, at Dennison, Ohio. After graduation he became a special apprentice on the Lake Shore & Michigan Southern, following which he was enginehouse foreman on the Lake Erie, Alliance & Wheeling (now New York Central); night enginehouse foreman on the Lake Shore & Michigan Southern, at Youngstown, Ohio, and roundhouse foreman on that road at Cleveland. In 1910 he became assistant to the mechanical engineer of the Lake Shore & Michigan Southern; in 1912 mechanical engineer of the Canadian Pacific, and in 1918 chief mechanical engineer of



William H. Winterrowd

that road. In 1923 he became assistant to the president of the Lima Locomotive Works, Incorporated. Three years later, in 1926, he was appointed vice-president of that company. Mr. Winterrowd accompanied Sir George Bury to Russia in 1917 to assist in compiling a report for the Russian government on its transportation system, and was in that country during the Kerensky revolution. He was president of the Canadian Railway Club in 1920-21. He has served as a member of the publication committee of the American Society of Mechanical Engineers and was chairman of that committee in 1932. He has taken an active interest in the Railroad Division of The American Society of Mechanical Engineers and is now chairman of its program and papers committee. Before leaving railroad service he was a member of the General Committee of the Mechanical Division of the A. R. A.

FREDERICK A. GEIER, president of the Cincinnati Milling Machine Company, died suddenly at his home in Cincinnati, Ohio, on March 27. Mr. Geier was born in Cincinnati on June 23, 1866. He had been engaged in manufacturing machinery since 1887 and had been president also of the Cincinnati Rubber Manufacturing Company, Factory Power Company, and Factory Colony Company. He was a director in many organizations, including the Cincinnati-Bickford Tool Company, the Cincinnati Rubber Manufacturing Company, and the Ohio Mechanics Institute. He held memberships in numerous clubs and associations, among them the National Society for the Promotion of Industrial Education and the American Society of Mechanical Engineers. In 1901 he helped organize the National Metal Trades Association and in 1910-11 was president of the National Machine Tool Builders' Association.

Personal Mention

General

D. WALLACE FISHER has been appointed superintendent of the Reading Transportation Company, highway subsidiary of the Reading, with headquarters at Philadelphia, Pa. Mr. Fisher was born at Manheim, Pa., on November 29, 1893. He was graduated from Stevens Technical School at Lancaster, Pa., in 1910. After serving



D. Wallace Fisher

for several years as a tool maker for the Hamilton Watch Company, he was employed for two years as an automotive mechanic. In 1916 he entered the service of the Reading as a machinist in the locomotive shops at Reading, Pa., later being transferred to the office of the mechanical engineer as draftsman. In 1919 Mr. Fisher was appointed motive power inspector, being advanced to the position of assistant mechanical engineer in 1922. Mr. Fisher was appointed assistant superintendent of the Reading Transportation Company in April, 1928, and served in that position continuously until his recent promotion.

Purchasing and Stores

LORNE KILMER, assistant general storekeeper of the Grand Trunk Western, has been promoted to general storekeeper, with headquarters at Battle Creek, Mich., succeeding J. C. Jackson, deceased.

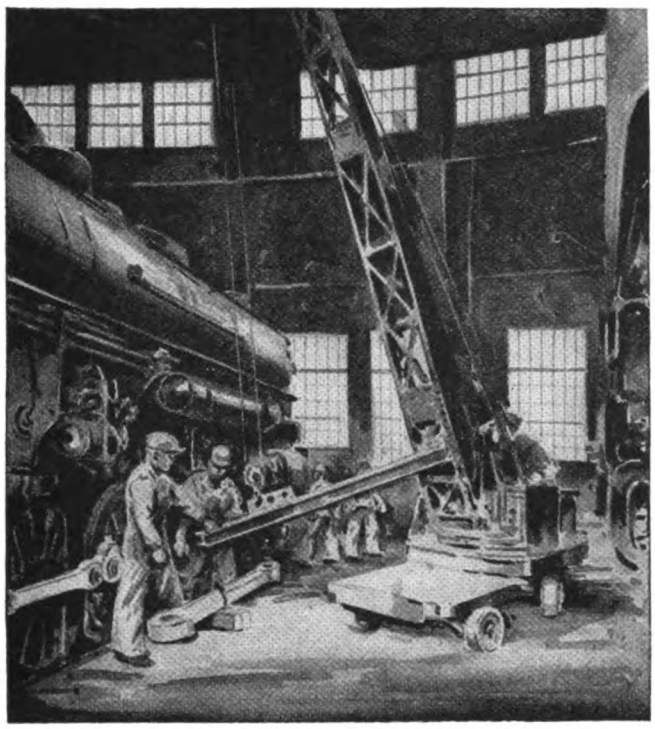
ARTHUR J. NEAULT, assistant general purchasing agent of the Chicago & North Western, with headquarters at Chicago, has been appointed to succeed John Ball, assistant general purchasing agent, deceased.

A. A. TAYLOR, assistant to the general purchasing agent of the Missouri Pacific Lines at St. Louis, Mo., has been promoted

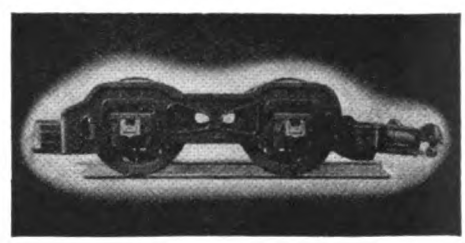
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The LOCOMOTIVE BOOSTER *produces* Power at a LOWER COST



If a locomotive cylinder must be made large to give the needed power at low speeds it is too big for road speeds. Because the big cylinder is used continously there is no chance to cut down on the work done and hence cut down on maintenance. You are still paying the full maintenance whether or not you are working to capacity.

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Take full advantage of all the economies of The Locomotive Booster and incorporate it in the original design.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

to the newly-created position of assistant general purchasing agent with headquarters at St. Louis.

WILLIAM S. MOREHEAD, who has been appointed general storekeeper of the Illinois Central, has been connected with this company for 32 years. Mr. Morehead was born at Bowling Green, Ky., and entered the service of the Illinois Central in 1902, in the office of the roadmaster at Water Valley, Miss. Two years later he was sent to New Orleans, La., as chief clerk to the roadmaster, being transferred to Nashville, Tenn., in 1905. Mr. Morehead was appointed assistant chief clerk to the superintendent at McComb, Miss., in June, 1907, and in the following year he was promoted to the position of division store-



William S. Morehead

keeper at the same point. In 1913 he became assistant general storekeeper at Memphis, Tenn., being transferred to Chicago in 1917 where he remained until his promotion to general storekeeper.

Obituary

WILLIAM DAVIDSON, general storekeeper of the Illinois Central, who died on February 22 had been connected with the Illinois Central for 41 years. He was born



William Davidson

on March 16, 1874, at Selma, Ala., and after a public school and business college education he worked for two years for the United Gas & Improvement Company at Vicksburg, Miss. In 1893 he entered railway service as a car repairer on the Illinois Central at Vicksburg and later served successively as master car builder clerk, wheel clerk, storekeeper, file clerk, assistant timekeeper, general timekeeper, accountant, storekeeper and assistant chief clerk to the master mechanic. On June 1, 1908, Mr. Davidson was promoted to the position of division storekeeper at Vicksburg, and on May 1, 1910, he became assistant general storekeeper at Chicago. He was appointed general storekeeper of the Illinois Central System at Chicago on May 1, 1917. Mr. Davidson had been active in the affairs of the Purchases and Stores Division, American Railway Association, for many years and served as chairman of that division in 1929.

J. H. THORUP, who retired in 1926 as local storekeeper of the Chicago & North Western at Chicago, died on March 22 at Chicago, at the age of 77 years.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

TRIPLE DIE STEEL.—Cromovan triple die steel is described in a four-page illustrated folder issued by the Firth-Sterling Steel Company, McKeesport, Pa.

GRINDERS.—The Monarch Machine Tool Company, Sidney, Ohio, has issued a new two-color catalog which pictures and describes in detail its new Precision toolroom surface grinder.

CRANK-PIN GRINDER. — The Micro portable locomotive crank-pin grinder is illustrated and described in Bulletin 105 issued by the Micro Corporation, Bettendorf, Iowa.

FORGING MACHINES.—"What Is a Modern Forging Machine?" is the title of a 27-page illustrated booklet issued by The National Machinery Company, Tiffin, Ohio. The construction of the National high duty forging machine is described in detail.

RIVERSIDE PRODUCTS. — The Riverside Metal Company, Riverside, N. J., has issued booklets on nickel silver, phosphor bronze, and Beryllium copper, which metals are available in rods, wire, sheets, strip, bars and blanks for a diversity of applications.

SPOT AND PROJECTION WELDING EQUIPMENT.—A new line of spot and projection welding equipment for manual or motor operation is described in an illustrated leaflet issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

UNION COLD-FINISHED SHAFTING.—The physical properties, straightness, warpage, etc., of Union Cold-Finished Shafting are discussed in a 16-page illustrated booklet issued by the Union Drawn Steel Company, Massillon, Ohio. A four-page bulletin has also been prepared on Union Cold drawn steels.

INTERNAL COMBUSTION ENGINE FUEL.—Under the title "A New and Better Fuel for Internal Combustion Engines," the Philgas Company, General Motors Building, Detroit, Mich., has issued bulletin No. 38 which describes the advantages of liquefied petroleum gases, such as butane and propane, for general use as a motor fuel. The bulletin describes the block testing of engines operated with this type of fuel and used for large stationary engines, pumping and generator engines, power rail car engines, and other applications.

MACHINE GAS CUTTING.—Facts about the machine gas-cutting process and the machines themselves have been compiled in an attractive 92-page booklet issued by the Air Reduction Sales Company, Lincoln building, New York. Numerous illustrations show the range and scope of machine cutting, and separate chapters are devoted to details concerning the Airco-D-B radiagraph, camograph, omnigraph, tramograph, oxygraph, and travograph.

ELECTRICAL EQUIPMENT FOR RAILROADS.—A 60-page circular, No. 1966, entitled "Electrical Equipment for Railroad Shops and Maintenance of Way," has been issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. It is divided into four sections: Part I, Opportunities for Reducing Operating Costs by Electrical Modernization; Part II, Equipment for Electrical Modernization; Part III, Service, Repairs, Renewal Parts, and Part IV, Index to Westinghouse Products for Steam Railroads.

THERMIT WELDING.—"Thermit Welding —Industry's Master Maintenance Tool," is the title of an illustrated booklet published by the Metal & Thermit Corporation, 120 Broadway, New York. The booklet describes Thermit welding, an alumino-thermic process which has been successfully employed for more than 30 years in the welding of heavy sections of ferrous metals. The actual welding of railroad track and the repair of large parts, crankshafts, and similar articles by the Thermit Process are also covered. Actual cost data are given in a number of instances.

LATHES.—A 72-page general catalog, No. 94, showing the complete line of South Bend lathes and attachments for repair shops, equipment and instrument maintenance shops, experimental laboratories and general machine shops, has just been issued by the South Bend Lathe Works, 426 East Madison street, South Bend, Ind. The catalog describes and prices 96 sizes and types of lathes, all of the back-geared, screw-cutting type, ranging from small bench lathes up through the medium sizes to large swing lathes. A new line added to this general catalog is the underneath belt motor-driven lathe.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

May, 1934

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices,
30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: **Terminal Tower**
Washington: 832 National Press Bldg.
San Francisco: **58 Main St.**

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Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States and possessions: 1 year, $3; 2 years, $5. Canada, including duty: 1 year, $3.50; 2 years, $6. Foreign countries: 1 year, $4; 2 years, $7.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.

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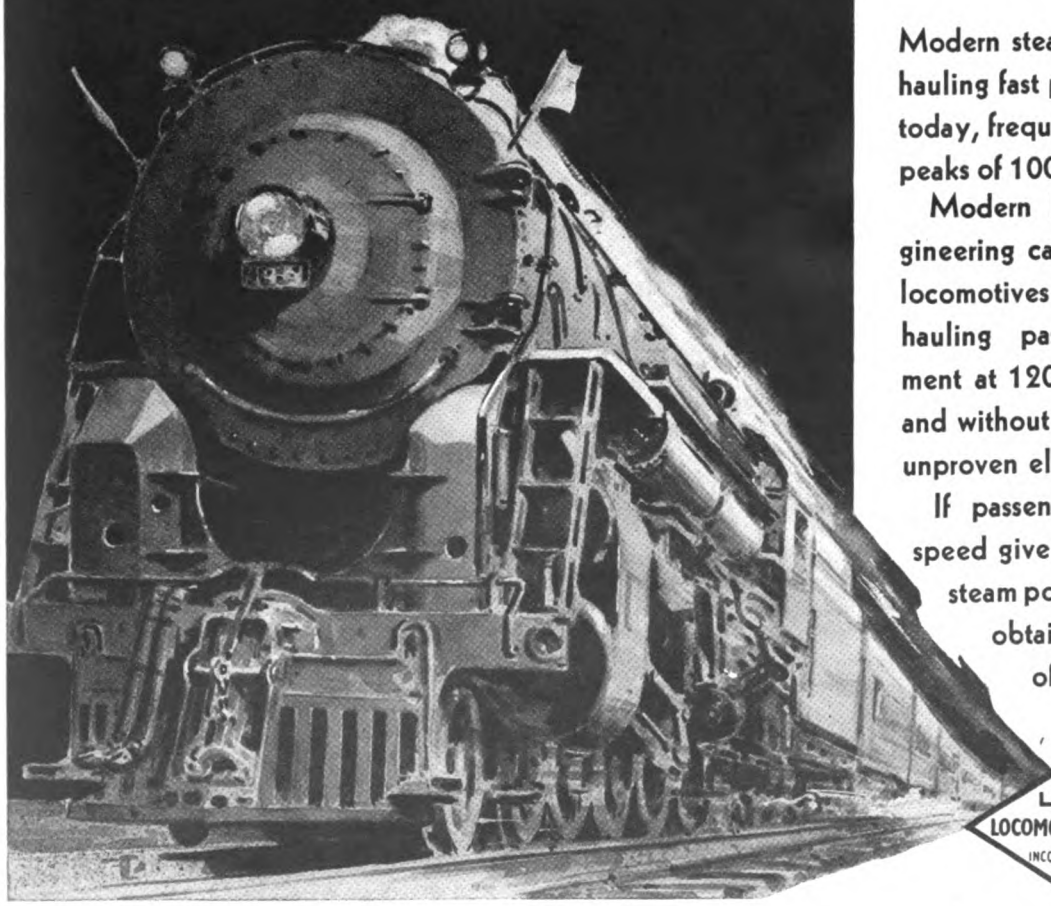
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If passengers want high speed give it to them with steam power and thereby obtain a maximum of safety.

LIMA LOCOMOTIVE WORKS INCORPORATED

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

May - 1934

Diesel Engines for Locomotives and Cars*

By R. Tom Sawyer†

Highly developed specialized designs of Diesel engines provide economical and reliable power units for locomotives and rail cars

THE first Diesel engine which was originated in Germany by Rudolf Diesel had the same fundamental principles that it has today; that is, it burned fuel oil and required no spark plug for ignition. The fuel oil is ignited by simply compressing the air to a very high temperature. A Diesel locomotive is a locomotive which contains one or more Diesel engines, power being transmitted electrically or otherwise to the driving wheels. The fuel oil universally used today is partially refined for this particular purpose and is similar to that burned in the oil furnaces in houses, being a higher grade than that used in oil-burning steam locomotives.

The overall thermal efficiency of the engine is between 20 and 35 per cent, depending upon the service and type, the thermal efficiency of a Diesel locomotive being considerably higher than any other practical type of locomotive known. Tests show that the Diesel locomotive will use only one half as much fuel as a gasoline locomotive and only one fifth to one tenth as much fuel as an oil-burning steam locomotive in the same service.

Engines for automobiles, rail motor cars and Diesel locomotives are similar—all three use the four-cycle engine—the only difference being the fact that the Diesel engine burns fuel oil instead of gasoline and the fuel oil is injected directly into the cylinders instead of sucked up through the carburetor as gasoline is in a gasoline engine. The Diesel engine is not a mystery to those who once understand that it is similar in construction to a gasoline engine, but far more economical and rugged as required for railroad service.

Progress in Development

There is a very definite place for the Diesel locomotive in the railroad field. That place is primarily in switching and transfer service. The time may come, however, in which it will replace the steam locomotive to a greater extent than now seems probable. I, personally, look forward to an overlapping of various types of motive power so that no one type will ever be universally used for all forms of transportation.

There are close to 1,000 gasoline rail cars and over 100 Diesel locomotives in service in this country today. They all use internal combustion engines.

Four years ago I visited several bus and truck manufacturing companies in England and at that time asked why they did not use a Diesel engine, as the price of gasoline there was abnormally high. In one factory the assistant general manager in answer to that question gave 18 different reasons why a Diesel engine could not be used in a bus. Some of his reasons were that it was too heavy; it smoked; the odor was too smelly and it didn't have the power. Last summer I visited the same factory again. The same man took me through the same shop and there in the production line of engines coming through were Diesel engines only, the type which four years ago was condemned as impractical. This engine was not too heavy; did not smoke; did not have any bad odors, and had the same horsepower as the gasoline engine which it replaced. This engine is now used in over 100 London buses. It is slightly heavier than the gasoline engine formerly used, but not too heavy; it costs considerably more than the gasoline engine, but the saving by using fuel oil amply justifies the higher first cost. The situation in other factories visited was similar—practically the whole production having been switched from the gasoline engine to the Diesel.

A typical four-cycle Diesel engine weighs only 11 lb. per hp., including all auxiliaries, or less than any two-cycle engine that I know of for railway service. Many early automobiles had two-cycle engines; today the automobile universally uses simple four-cycle engines. In 1917 the largest builder of gasoline rail-car engines at that time brought out a two-cycle Diesel engine, but today the four-cycle engine still leads and should con-

* Abstract of a paper presented before the meeting of the Western Railway Club held at Chicago, April 16, 1934.

† American Locomotive Company.

tinue to lead in railway service, due to its simplicity of maintenance and operation.

In this country the first Diesel locomotive was sold in 1925 to the Central Railroad of New Jersey. That was only nine years ago. That particular Diesel locomotive has given exceptionally good results when we consider that it was the first.

Types of Transmission for Diesel Locomotives

The question is often raised as to what type of transmission should be used in transmitting the power of the Diesel engine to the driving wheels. The electric drive has been universally adopted for heavy switching Diesel locomotives, while the mechanical drive is generally used in the small industrial locomotives of 20 tons or less. In addition to electric transmission there are four other means of transmitting the power.

One type is a mechanical drive, similar to that of an automobile using a friction clutch and gear box. For small locomotives this transmission is satisfactory. Another type is the direct mechanical drive where the clutch and gear box are eliminated; that is, the Diesel engine is connected directly to the driving wheels. The first locomotive of this type was built in 1912 in Switzerland and proved unsatisfactory. Another locomotive is now in trial service in Germany. In both cases the locomotives are started by compressed air and, naturally, starting the locomotive means starting the Diesel engine together with the entire train. I mention this type of drive because it appears to be the simplest type to build and of interest to watch.

A third type of air transmission; that is, the Diesel, is coupled directly to an air compressor which supplies air to drive the pistons in the cylinders placed on the locomotive in the same manner as steam cylinders on a steam locomotive. Up to date none of these locomotives has been successful. This is true also of the heavy duty locomotives using hydraulic transmission. Electric transmission is generally preferred today in this country, especially in heavy switching service where the locomotive is continuously starting and stopping. However, the Diesel has really not entered the field of pulling heavy fast freight trains, but when—and please note that I did not say if—that day comes there may be a question as to what type of transmission or arrangement of engine should then be used.

Comparative Characteristics of Diesel-Electric and Steam Locomotives

The question is often asked "Why does the tractive force of a Diesel-electric locomotive drop so rapidly?" The answer is that the horsepower of the Diesel engine is constant regardless of the speed of the locomotive, due to the fact that the power is supplied through electric transmission. The cylinders of a steam locomotive are coupled directly to the driving wheels and for this reason the steam locomotive may have a small horsepower in starting but additional power is developed rapidly as the locomotive picks up speed. This is a fundamental fact which we must understand in order to appreciate the difference between a steam and a Diesel-electric locomotive. That is the reason why a Diesel locomotive which has only 600 hp. can do a better job in switching service than a steam locomotive which may have 2,000 hp. at 30 m.p.h., as in yard switching service the operating speed seldom exceeds 10 m.p.h. and within this speed the steam locomotive actually develops less horsepower than the Diesel locomotive.

Comparing the acceleration curves of a 75-ton steam locomotive and a 600-hp. Diesel locomotive (both suitable for switching service) handling a train of 1,000 tons. It is found that the Diesel locomotive gives an appreciably better performance up to 10 m.p.h. For example, it takes only 19 sec. for the Diesel locomotive to reach 6 m.p.h., while it takes 8 sec. longer for the steam locomotive to reach the same speed. However, the steam locomotive has a better performance above 10 m.p.h. and is, therefore, better suited for transfer and road service with this particular size of train.

Operating Costs

If a Diesel locomotive can be placed in approximately 24-hr. switching service it will more than justify its higher first cost regardless of the type and size of steam locomotive replaced. There may be exceptions, but as yet we have not found any. However, if the Diesel locomotive is to be operated approximately only 16 hrs. a day the costs should be analyzed to determine whether steam or Diesel is most economical. Generally speaking, it has been found that the Diesel engine is justified if placed in 16-hr. service, 6 days a week and as many as 300 days per year.

Cost of repairs varies greatly even on steam locomotives in the same class of service on different roads, and, therefore, it is extremely difficult to state what the costs of repairs will be on Diesel locomotives on a certain road even though we know what their costs are on a neighboring road. It is fair to assume that the cost of repairs is equal to or less than the steam locomotive. It can be assumed that the miscellaneous expense of the Diesel locomotive is equal to the miscellanous expense of the steam locomotive.

The cost of lubricating oil for a Diesel locomotive is greater than for a steam locomotive and, on the other hand, the water consumption on a Diesel is negligible. It is of interest to note that service data show the lubricating oil cost of a Diesel locomotive is generally equal to, or less than, the combined cost of lubricating oil and of water on the steam locomotive which it replaces.

Therefore, we have only three factors which vary appreciably. The cost of fuel on the Diesel locomotive is far less than the cost of fuel on the steam locomotive, whether it burns coal or oil. The cost of labor is considerably less on the Diesel locomotive, because there is not one Diesel locomotive in service in this country that uses a fireman; there is no work for the fireman and, therefore, no need or reason for having one. In a few cases a second man in addition to the engineer is used on the Diesel locomotive, but in no case is a fireman required or used. The third factor is enginehouse expense. This expense covers two sub-factors: First, the overhead cost of the enginehouse and, second, the cost of work on the locomotive when it is in the enginehouse. The overhead cost cannot be changed, generally speaking, whether steam or Diesel locomotives, or both, are used, yet if the Diesel locomotive is kept in 24-hr. service six or seven days per week it seldom enters the enginehouse and, therefore, cost of actual work on the Diesel locomotive is considerably less than that on the steam locomotive.

There are many incidental savings obtained by using Diesel locomotives which cannot be so directly accounted for. These savings are, however, real and include track maintenance to some extent, elimination of water and coaling facilities and elimination of double heading in certain cases where the high starting tractive force of the Diesel locomotive has an advantage over the steam locomotive. There is also, in some cases, a saving due to the fact that the Diesel locomotive can enter factories and warehouses where the steam locomotive is required to stay out and use reachers consisting of a string of cars to enter the building.

There is now a considerable amount of real operating data available as to the Diesel and, with service condi-

tions specifically outlined, accurate comparative costs of Diesel and steam locomotives can be made. The decision as to whether the Diesel or steam locomotive is purchased should be based on an analysis of these comparative costs.

Diesel Engines for Rail Motor Cars

There are today approximately 1,000 gasoline rail cars in service in this country and these have played an important part in the development of the Diesel locomotive. These rail cars have proved that there are at least some cases where more economical power than steam can be used. Although steam locomotives are generally employed, something else should be used when it is more economical. The rail car has also served to take away the mystery surrounding the internal-combustion engine and has taught the steam man how to operate and maintain internal-combustion engines in railroad service and, incidentally, has shown him their advantages and economical benefits. The Diesel is to the mechanic simply a glorified, simplified gasoline engine.

The era of the single-unit rail car is passing; it was put in as a stop gap to reduce losses. The car and the branch over which it operated will in many cases be abandoned. Rail-car development is toward more capacity, more speed, and is leading up to the new high-speed articulated units operated with internal-combustion engines as the power. These new units, in a new field, are closing the gap between the branch-line rail car and the high powered steam passenger locomotive. Just a word as to the power to be used by these units and the future higher powered rail cars, or locomotives. There can be, in the light of today's developments, but one forecast and that is that the Diesel engine will be used practically exclusively where steam does not continue to hold its preeminence.

Multiple-Unit Diesel Trains Suggested

Many of you may not appreciate the fact that there was a day when competent engineers said that multiple-unit electric trains could not be operated successfully; that trains similar to the Chicago electric elevated lines as operating today were not practical. The first elevated trains in Chicago were pulled by steam locomotives, then by electric locomotives, and later, here on the South Side Elevated, Frank Sprague first proved the practicability of his multiple-unit invention. A multiple-unit train is a train that has the driving power placed on each car, or on every other car as the case may be, and where the motors on all cars are controlled from either end by one master controller.

Multiple-unit electric car operation is now almost universal. There are about 10,000 such cars in service today in this country. The traction motors are on individual cars, but all can be controlled from any car in the train. With this remote control the electric cars have real flexibility. Each car can be moved as an individual unit and the number of these individual units which can be coupled together in a train is practically unlimited.

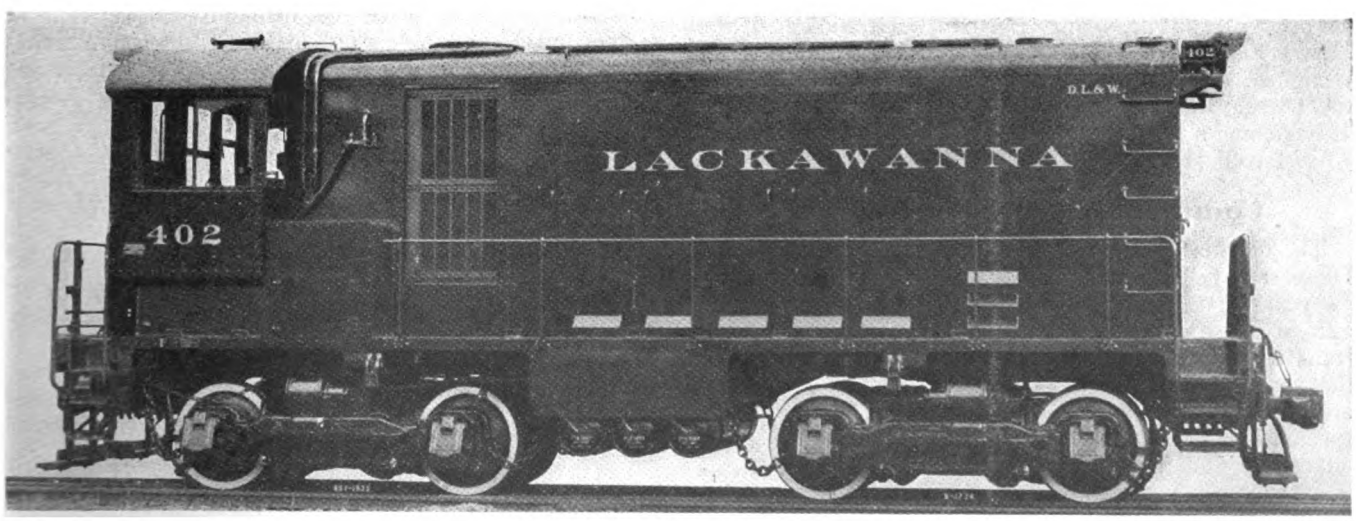
The Diesel locomotive or rail car is operated from a control stand. There is no reason why a similar control stand cannot be in a distant car with small electric control wires in a jumper connection between the cars similar to the jumper connections on the electric multiple-unit trains. These small electric control wires running throughout the train would control the Diesel engines located on the individual cars from the control stand in the front car. This is practical and opens up an enorous field of possibilities. Such an arrangement, with suitable couplers, is used on Diesel-electric multiple-unit cars of the Netherland Railways.

We could take a single car, equip it with a Diesel power plant of say 400 hp., and with a suitable electric transmission that car could be operated at, say, 80 m.p.h. between New York and Chicago. Now visualize 10 or more of these motor cars each with a trailer, coupled together in one train and all controlled electrically from the front car and you have a picture of future possibilities.

This arrangement would solve one great problem—a perplexing one which is confronting steam railroads today. The question is how large shall one Diesel power plant be to handle an entire train; shall it be 1,000 or 2,000 or even more horsepower? Would it not be much simpler from an operating standpoint to discard the one big Diesel power plant and place a small power plant on each car? Then it would make no difference whether there be six cars required in train No. 1 today or 16 cars in the same train tomorrow.

Rail cars or streamlined Diesel trains of today operate independently. However, Diesel multiple-unit cars must be built so as to be interchangeable and operate on any road; that is, a standardized air brake system should be used, as is now used on all passenger cars today; standard M. C. B. couplers; a standard control should be decided upon—a simple control—so cars manufactured by different companies can operate in the same train.

This is not a new idea, for it has been tried with gaso-



A 600 hp. Diesel-electric locomotive built by the American Locomotive Company for the Delaware, Lackawanna & Western

line engines. A good Diesel engine should require no personal attention when in operation. When this thought of using multiple-unit Diesel cars is given consideration one immediately realizes that a Diesel propelled train of even 4,000 hp. is available today. The cost of such a train brings on the old adage: "More expenditure means greater production and high production means low cost." There is practically no limitation to the operating range of the Diesel multiple-unit train, for regardless of the size it would have ample power to operate on a fast schedule from Chicago to St. Louis, New York or California.

Freight Train Service

Although multiple-unit Diesel freight trains as a future possibility would open up an interesting discussion, I am not going into that field tonight. I simply wish to point out that multiple-unit Diesel freight trains are a practicable possibility. On electric interurban lines freight trains are not generally hauled by electric locomotives, but are handled by one or more freight cars equipped with electric traction motors. If these same cars were equipped with Diesel power plants they could be operated on any steam road. With but few exceptions the rail car in this country, until now, has been applied primarily to passenger service. However, in Germany there are a number of installations where the Diesel rail car is used exclusively for freight service. Here is a virgin field, a field to which practically no serious consideration has been given; that is, the application of the Diesel freight car.

In order to improve service in the future you are told you must speed up your service. I am naturally biased in favor of the Diesel, but the call for the Diesel is not due to the need for more speed. Twenty, yes thirty, years ago the steam locomotive was operated at as high a speed as a passenger-carrying train on rails should be operated today. More power or change of design can overcome the added wind resistance, but we must recognize rail limitations. No locomotive can, or rather no locomotive should, attempt to pull a train faster than the rails can carry the load safely. The call of the day is for something different; something more economical, something more attractive, but not necessarily more speed.

The steam locomotive has been brought up to its present high standard only after a century of experience in actual service. The Diesel locomotive of today has passed through only nine years of actual service in this country. In 1925 many railroad men ridiculed the Diesel locomotive. Today, all thinking railroad men recognize that there is a legitimate, economical field for the Diesel; the only question is what are its limitations. It has come a long way in nine years and to my mind it is just well started.

Comments by W. L. Garrison*

The original specifications for the first Ingersoll-Rand Diesel engine for railroad application were drawn up 14 years ago. After 10 years service experience with 125 of these engines in various classes of switching, transfer and branch line service, operating records show that original requirements were correct both as to detail and order of importance. For railroad service these specifications demanded positive requirements from the oil engine and their order of importance was and still is as follows: 1. Reliability. 2. Good balance. 3. Relatively high speed and low weight. 4. Accessibility with low maintenance. 5. Absence of noise and smoke. 6. Reasonable fuel economy. 7. Reasonable lubricating oil economy. 8. Reasonable first cost. If the Diesel engine is to justify its existence against the modern steam locomotive and continue to maintain its place in railroading, it must have reliability and low maintenance even though it costs more to build such an engine. Otherwise the Diesel locomotive cannot save enough in operating expenses to return a profit over its annual capital charges.

Consider the various demands made upon the locomotive oil engine. Experience has shown that the engine must meet successfully three different classes of service, each placing different demands upon the oil engine. These are: 1. Switching service. 2. Main line passenger or freight service. 3. Combination three-power locomotive service.

In switching service the oil engine operates 20-24 hours per day at variable speed. The engine is under almost constant acceleration and deceleration from no load idling to full load maximum speed, and must be capable of steady performance 6,000 to 7,000 hours per year. In this service the average load factor is low, from 12 to 25 per cent but the maximum power output may be demanded instantly and at frequent intervals.

The Diesel-electric rail car is characteristic of main line passenger service in which the engines operate from 12 to 17 hours daily at more nearly constant full load speed except for short intervals of coasting down grades or idling at station stops. The engines must be capable of sustaining full horsepower output over long periods, averaging as high as 70 to 85 per cent load factors if operating schedules are to be consistently maintained. For the past 15 months we have had a 600-hp. oil-electric rail motor car in revenue service on ten different railroads handling from one to five heavy trailers under all kinds of branch line, local and express service. Meter and time records of the engine and car performance have been kept from the start. The demands on the oil engines in this service are the same as those for large main line freight or passenger locomotives.

The so-called three-powered or oil-electric-battery combination locomotives are special both in service and in demands on the Diesel engine. Since the engine must supply electrical current for both the traction motors and charging the storage batteries, it must operate at constant full speed instead of variable speed under high load factors of from 50 to 60 per cent. Hours of service average from 5,000 to 7,000 per year although the engines get some respite since they may be shut down while the locomotives are operating on the third rail.

In addition to these service demands, railway Diesel engines must be strong enough and rigid enough to maintain alinement of their working parts and withstand the strains imposed by the flexibility of the locomotive or car frame. They must operate with no attendance and a limited supply of cooling water to dissipate the heat from cylinder heads and combustion chambers. Railroad service is far more exacting than either stationary or marine service.

Since locomotives and motor cars must have a reasonable weight for traction, safety and comfort, isn't it demanding too much of the Diesel power plant, which daily propels this equipment, to reduce its weight to a minimum, boost its rotative and piston speeds to a maximum and raise its brake mean effective pressure materially expecting at the same time long life in continuous operation, reliability and low maintenance.

A Diesel engine for railroad application should be good for a useful life of 25 years at 6,000 to 7,000 operating hours per year. This represents approximately 150,000 to 175,000 hours of operation which in itself is no mean task compared with that required of marine,

* Assistant manager, locomotive department, Ingersoll-Rand Company.

automobile or aeroplane engines. An automobile engine may have a useful life of 150,000 miles. At an average car speed of 20 miles per hour, that is only 7,500 hours of actual operation or one year service in railroading.

Comments by H. K. Smith*

The Westinghouse Electric & Manufacturing Company has been interested in the development of Diesel engines for railway service for a number of years and has developed a standard line of four-cycle engines based on a 9 in. by 12 in. cylinder and an engine r.p.m. of 900. This gives 66⅔ hp., from each cylinder, so we have in four-, six-, eight- and twelve-cylinder engines, 265, 400, 530, and 800 hp. With twin power plants of these sizes you can go up to 1,600 hp. We believe there will be few applications in the near future, for locomotives of greater horsepower than this. For main line and some transfer service more horsepower will be required but this can be obtained without larger engines by multiple operation. Incidentally, all these engines use the same pistons, liners, fuel pumps, and many other parts.

Our experience has been that with 9 in. by 12 in. cylinders and 900-r.p.m., engines with sufficient weight can be obtained to meet the ruggedness so necessary for railway service and with dimensions and weights well within the limits required for rail car service. The weight per brake horsepower is approximately 30 lb. With the aluminum pistons used it is feasible to lift out a piston and connecting rod without resorting to special lifting equipment; the piston and rod weigh about 90 lb.

The Westinghouse Company has expended considerable time and money experimenting with two-cycle engines. As has been brought out, there are various two-cycle engines in service today, particularly of the lower speed stationary type. The question is, is it possible when everything is considered, to get a more economical engine with the two-cycle principle than with the four-cycle principle which has been so successful in railway service? A possible advantage for the two-cycle engine is in a streamlined train where the light weight and space limitations are severe. I believe the complete Diesel-electric power plant with a two-cycle engine will not be as efficient as with a four-cycle engine, and it is questionable whether the weight and space saved can be justified.

We have also done some work with super-charging, and this offers a fertile field for the development of greater capacity for a given piston displacement.

* Westinghouse Electric & Manufacturing Company.

Comments by E. F. Kultchar*

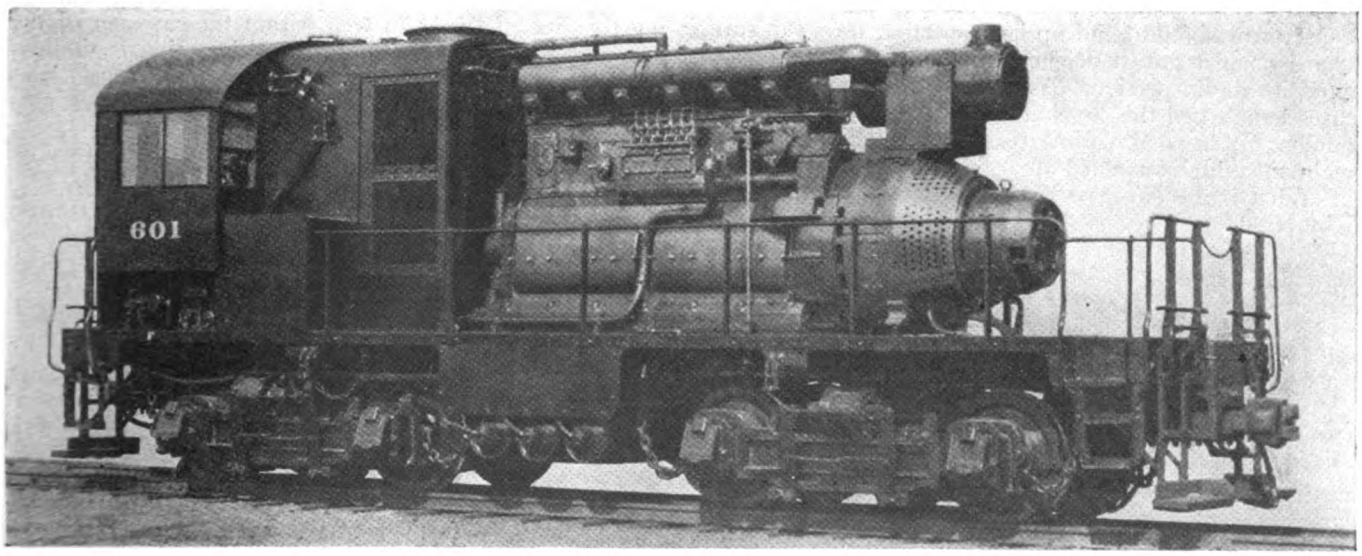
An argument regarding the merits of two- and four-cycle engines probably should have no place in a discussion of this paper, but this is necessary to avoid an incorrect impression. I believe it is generally recognized today that there is nothing inherent in either the two-cycle or four-cycle design which should condemn a Diesel engine for any job for which it is otherwise adapted. Either type, if a thoroughly-proven product, and if manufactured by a reputable company experienced in the Diesel engine field, may be depended upon.

The greatest advantage of the two-cycle engine is quite generally recognized to be its relative simplicity. As compared to the four-cycle, the two-cycle eliminates intake and exhaust valves and the rockers, push rods and cams required for operating them. For this valve mechanism which, under the high pressure and temperature conditions existing in a Diesel motor, must be maintained in practically perfect condition and adjustment, there are substituted, on the two-cycle engine, ports in the cylinder walls which are uncovered by the piston and a low-pressure air blower or pump to maintain about 3 lb. pressure on the manifold which connects the air intake ports. Other engine parts are common to both types. Advocates of the two-cycle maintain that the resulting simplicity offers advantages in the form of increased reliability, shorter shut-downs for inspection and maintenance, and lower maintenance cost. That this belief is justified by experience is evidenced by the rapid increase in the sale of two-cycle engines as compared to the four-cycle. In 1921, 15 per cent of the total Diesel horsepower sold in this country were of the two-cycle type and in 1931, 61.2 per cent.

It is logical to ask why anyone should build four-cycle engines with their comparative complications. Except for engines with small cylinders operating at high speed, say 1,000-r.p.m. or higher, in which the requirements for metering the fuel, i.e., governing, are at the present time beyond the possibility of such mechanism for two-cycle engines which have a much smaller fuel charge than four-cycle engines due to their being twice as many, there does not seem to be justification for the four-cycle

* Fairbanks, Morse & Company.

(*Concluded on page 156*)



A 600 hp. Diesel-electric locomotive built by American Locomotive Company with engine housing removed

Regaining Lost Passenger Traffic

PASSENGER traffic on the railways of the United States has decreased at an alarming rate since 1920. It had grown at a rapid pace from 1915 until 1920, when it reached its apex of 46.8 billion passenger-miles. The private automobile, the bus and the airplane made heavy inroads into it in the years following and the situation has been further complicated in more recent years by the depression. The revenue passenger-miles in 1933, for instance, amounted to 16.2 billion, as compared to a five-year average, 1925-29, of 33.5 billion, a reduction of approximately 50 per cent. The year 1933, however, will probably go down in history as marking the turning point in the start to regain this lost business.

The problem is being attacked vigorously in many ways, one important means being to improve the comfort and convenience of travel by improved appointments in the passenger train cars; also by the smoother and better handling of trains. Passenger traffic officers are enthusiastic over improvements which have been made in the equipment by the mechanical department, such, for instance, as air conditioning, improved lighting, more comfortable seats, easier riding equipment, etc.

Build Up Inspection Forces

What other things can the mechanical department do to assist in regaining lost passenger traffic? This is the question I put to a Passenger Traffic Official of a road which is noted for the high standard of its passenger service. He had no advance information as to what I wanted to see him about. His reactions were immediate, however, and very much to the point.

"Under the difficult conditions through which we have been passing," replied the Railway Traffic Officer, "it has been necessary to reduce expenses to a very minimum. The mechanical inspection forces at the division points, as in all other departments, have been hard hit. It is true that we have been extremely careful with our smaller inspection forces to maintain high standards from the standpoint of safety and prevention of accidents. On the other hand, the smaller forces have made it necessary to ease up on some details which do not affect the safety, and yet which are quite likely to prevent or overcome deficiencies which are irritating to the passengers and may result in delays in operation. Just as quickly as conditions will permit, the mechanical department should build up its inspection forces to safeguard against any deficiencies of this sort and also to expedite the inspection. As it is now, we have in some cases lengthened the stops at stations to give the smaller number of inspectors time to get over the ground and maintain a high standard of inspection."

"What is the effect of lengthening stops at stations?" I inquired.

"Not so good," replied P. T. O. "The average traveler, when he gets started on the train, wants to get to his destination as quickly as possible, and he is quite likely to become impatient at prolonged stops at stations."

"Does this mean, in your opinion, that we ought to operate our trains at higher speeds?" I asked.

"Not necessarily," replied P. T. O., "but it does mean that we ought to do everything possible to keep the wheels rolling. While some of our passengers may prefer higher speed trains, many of them, and particularly the women, prefer a medium speed. You must realize, also, that the time between terminals for many of our trains can be considerably lowered on some runs by reducing the length of time standing at intermediate stations."

Mechanical department can assist materially in a number of different ways

Dimming Lights at Night

"Have you anything to suggest concerning passenger coaches, for such travel would seem to be of vital importance in building up the passenger business and revenues?"

"In general," replied P. T. O., "the mechanical department has made an excellent job of improving the comfort and conveniences in the passenger coaches, as well as improving their riding qualities. We must not forget that many of the coach travelers spend the night on the train and we must do everything possible to make the riding comfortable and give them an opportunity to rest. We cannot put out all of the lights and some passengers are annoyed, even if most of the lights are put out, if a few still remain brightly lighted. The mechanical department can make quite a contribution if it can find some way of dimming the lights which remain lighted. Technically, I imagine this is not a difficult job, because we see applications of it in both home and theatre lighting.

Eliminate Rough Riding

"There is another phase of passenger train operation that cannot be too strongly emphasized," continued P. T. O. "I cannot understand, for instance, why some trains can be operated smoothly and without jolts, whereas other trains with similar locomotives and the same number of cars are handled so roughly as to provoke comments on the part of passengers. It looks to me as if this is purely a matter of craftsmanship and that adequate training and educational methods, with discipline it necessary, can be applied so that all of the enginemen can give the same high grade of service that some of them do. I realize, of course, that if a locomotive is overloaded it is difficult or even impossible to prevent a certain amount of rough handling, but we in the passenger traffic department are strongly for keeping the size of the train well within the capacity of the locomotive to handle smoothly. When this is done it seems to me that there is no excuse for the rough handling of passenger trains, particularly since it does provoke criticism on the part of the passengers."

Air Conditioning

"What in your opinion is the most important contribution that the mechanical department has made in passenger train cars within recent years?"

"By long odds, the application of air conditioning," replied P. T. O. "This is certainly the greatest improvement that has been made in passenger traveling in the past quarter century. Controlling the temperature and the moisture content of the air is only part of the excellent results secured. The elimination of dirt and cinders and the great reduction of noise inside the car have added much to the comfort of the traveler. In my opinion, this feature, together with other conveniences that have been added to the equipment, will be most helpful in assisting to regain passenger traffic."

High-Speed Stainless-Steel Train Built for the Burlington

The streamlined "Zephyr," built by the Edward G. Budd Manufacturing Company's Shotweld process, weighs 195,000 lb. With 600 hp. at the generator it exceeded 100 m.p.h. on its trial runs

THE Burlington Zephyr, built by the Edward G. Budd Manufacturing Company, Philadelphia, Pa., was christened before a party of invited guests at the Broad Street Station of the Pennsylvania Railroad at Philadelphia, Pa., on April 18, following which it started on an exhibition tour of eastern cities. This will be followed by a similar tour of the west before the train is placed on exhibition for the summer at A Century of Progress Exposition, Chicago. It was built specifically for a round-trip daylight run between Kansas City, Mo., Omaha, Neb., and Lincoln, on which it will be placed in the fall.

The Zephyr is a three-car articulated train of lightweight stainless-steel construction, with smooth streamlined surfaces to permit of high-speed operation. It is powered by a 660-hp. Winton Diesel-electric power plant, and on its trial run developed speeds in excess of 100 miles an hour on level track with no wind. Wind-tunnel tests of scale models conducted at the Massachusetts Institute of Technology indicate that at an operating speed of 95 m.p.h. the resistance to motion should be reduced to about 47 per cent of that of a train of three coaches of conventional shape, but of equal weight.

The train consists of three car bodies carried on four trucks and is approximately 197 ft. in length. In the first car, aside from the operator's cab and the engine room, there is a 30-ft. mail compartment and a short baggage compartment, which is continued at the front end of the second car body. These two compartments are designed to carry 50,000 lb. of baggage and express. Seats for 72 passengers are provided at the rear end of the second and in the third car bodies, of which 12 are in the solarium lounge at the rear end of the train. The buffet-grill in the second car provides light meals which are served at the seats in the passenger compartments.

Shotweld Stainless-Steel Construction

The truss form of construction which has been developed by the Edward G. Budd Manufacturing Company for the utilization of built-up sections of thin-gage stainless steel, joined by the Shotweld process, is used in the car-body structure and, to a large extent, the entire body structure, from floor to roof, performs load-carrying functions. The truss members are generally of flanged box sections formed of deep channels and cover plates joined by Shotwelds. The stainless steel (18 per cent chromium and 8 per cent nickel) by which these sections are formed has a minimum tensile strength of 150,000 lb. per sq. in. and an elastic limit of 120,000 lb. per sq. in., with satisfactory ductility.

One of the illustrations shows a specimen of a section originally 14 in. in length tested to destruction in compression and reduced to a length of 6¾ in. without a break in the material. This member, of material 0.050 in. thick, has a sectional area of 0.51 sq. in. and weighs 1.77 lb. per lineal foot. Its moment of inertia is 0.35 in.^{4} about either axis, and its radius of gyration is 0.8 in. It withstood under compression 36,000 lb., or over 70,000 lb. per sq. in. After failure had started the load required to continue the destruction varied up to a maximum of 28,000 lb.

The tenacity of the welds is also clearly indicated in the illustration of the failed specimen. The Shotweld process, developed and patented by the Edward G. Budd Manufacturing Company, effects a specific regulation of

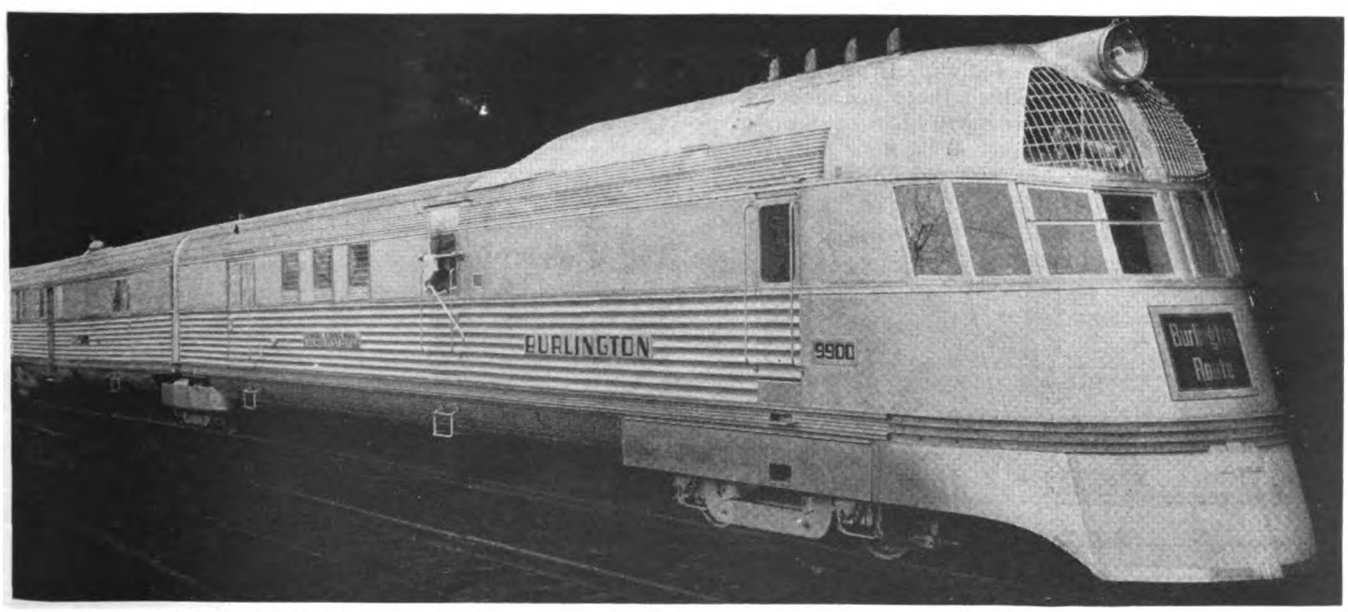
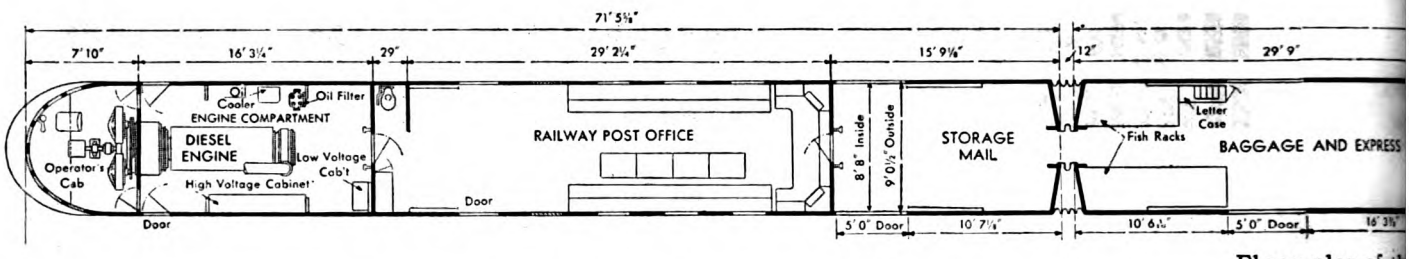


Photo by Wendell MacRae, New York

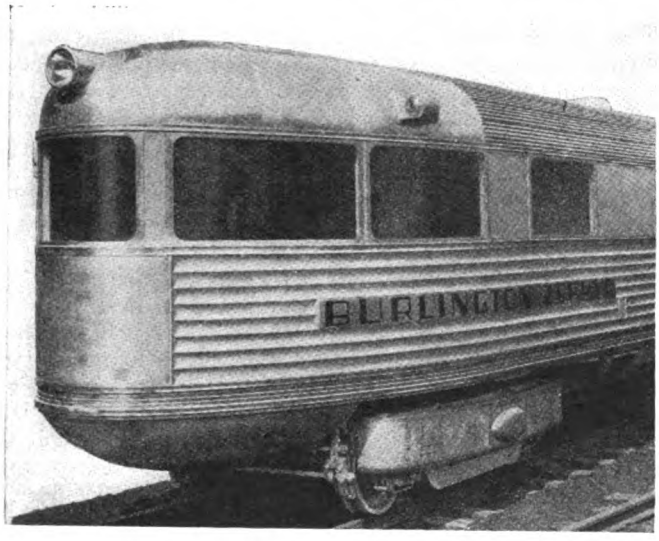
The Burlington Zephyr



Floor plan of th

the pressure, the electric current value and the duration of its flow, thus maintaining unimpaired the strength and corrosion-resisting properties of the material. The welds develop a shearing strength of 75,000 lb. per sq. in. and will withstand torsion up to 90 deg. before rupture. All welding in the structure of the Burlington train was done by this process.

Each car body is built with a camber of ⅝ in. and is designed for a deflection of ⅜ in. at 150 per cent of full load. The main members of the car body are the Pratt-truss side frames which have, in effect, been car-



Exterior of the observation-lounge

ried up to the roof by the use of diagonals in wide deadlights between the windows and of which the roof forms a part of the top chord. The floor structure is made up of a corrugated sheet of stainless steel, the bottoms of the rectangular corrugations of which are welded to a flat sheet and both in turn welded to the longitudinal stringers, of which there are eleven across the car. These, in turn, are secured to transverse supports built into the car frame. The floor thus forms a stiff horizontal girder through which end loads are distributed to the side girders. In the baggage compartments it is designed for a loading of 600 lb. per lineal foot.

The roof constitutes a primary structural member assuming the compression load. It is built-up of longitudinal corrugated sheets welded to roof carlines and is locally reinforced at points of maximum stress. The roof-sheet corrugations are $\frac{7}{16}$ in. deep, with a pitch of 1½ in.

The enclosure below the floor is of only incidental value as a part of the load-carrying structure and the trussed center sills are designed primarily to serve as means of attachment for apparatus, to stabilize the floor beams and to serve as local reinforcement.

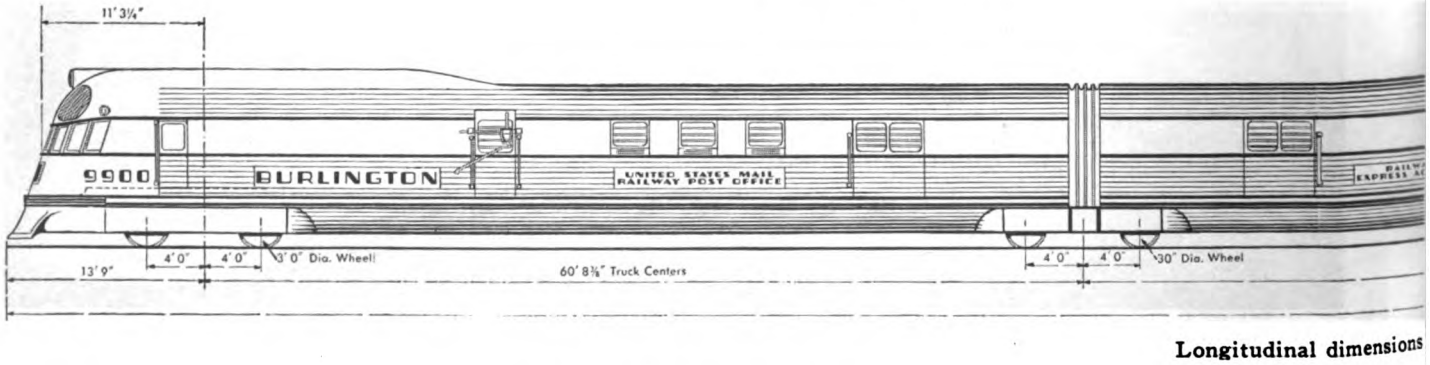
Special Features of the Body Construction

The engine-bed, fabricated by Lukenweld, Inc., is a rigid arc-welded structure of steel plate, annealed after completion of the welding. It forms a combination bumper, engine bed and bolster and is 25 ft. 3½ in. long, by 8 ft. 8 in. wide. The material is Lukens Steel Company Cromansil, an alloy of chromium, manganese and silica limit of 90,000 lb. and an elastic limit of 70,000 lb., possessing a high resistance to fatigue and shock. The completed structure weighs 6,070 lb. It is built into the lower chord member of the side trusses and forms the foundation for the nose structure of the car.

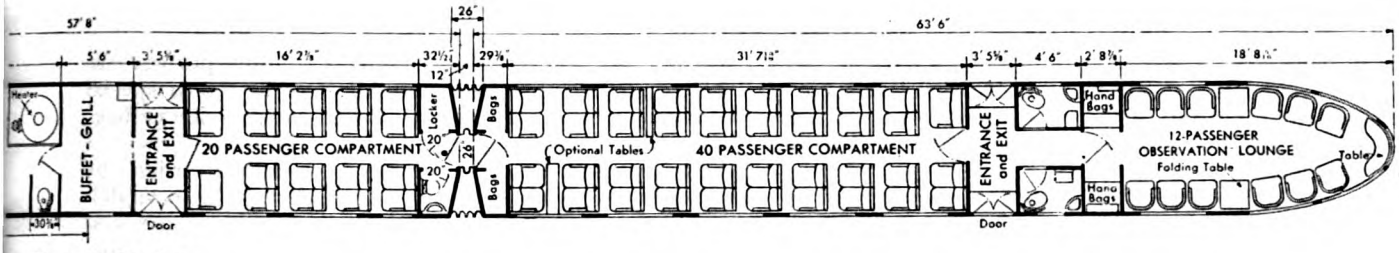
The nose construction consists of a deep, stiff member which extends diagonally outward and downward on the longitudinal center plane of the car from the roof

Principal Dimensions and Weights of the Burlington "Zephyr"

Length overall	197 ft. 1⅜ in.
Length from pilot to center power truck	13 ft. 9 in.
Length center of power truck to center of first trailer	60 ft. 8⅜ in.
Length from center of first trailer to center of second trailer	58 ft. 8 in.
Length from center of third trailer to center of fourth trailer	52 ft. 7 in.
Length from center of rear trailer to the end of train	11 ft. 5 in.
Height from rail over engine room	12 ft. $13/16$ in.
Height from rail to roof	11 ft. $2\frac{7}{16}$ in.
Height from rail to floor (passenger compartments)	3 ft. 7 in.
Width overall	9 ft. 8½ in.
Wheelbase of trucks	8 ft. 0 in.
Wheel diameters:	
Power truck	36 in.
Trailer trucks	30 in.
Center plate height, loaded (trailer trucks)	$25\frac{25}{32}$ in.
Nominal journal sizes:	
Power truck	6 in. by 11 in.
First trailer truck	5½ in. by 10 in.
Second trailer truck	5 in. by 9 in.
Third trailer truck	4¼ in. by 8 in.
Light weight of train	195,000 lb.
Estimated weight distribution with normal load:	
Power truck	98,000 lb.
First trailer truck	67,000 lb.
Second trailer truck	45,000 lb.
Third trailer truck	30,000 lb.
Height center of gravity above rail	51 in.



Longitudinal dimensions

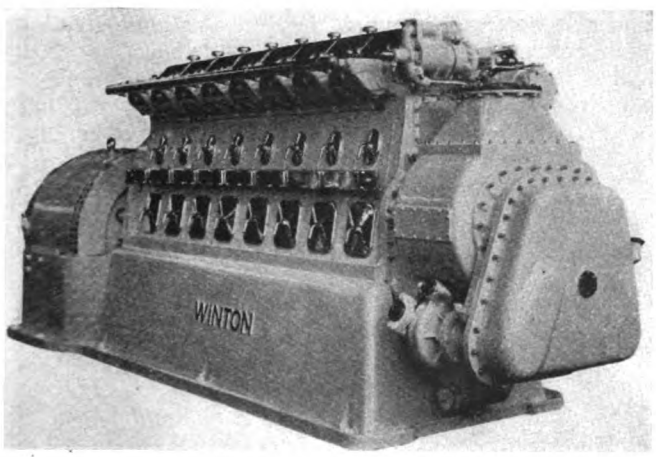


Burlington Zephyr

to the bumper portion of the engine bed. This is reinforced with a stiff horizontal arch at the belt rail and with a ¼-in. diaphragm which forms the bottom of the engine-cooling air-intake chamber above the cab windows.

Each articulation casting is tied into the frame structure at the end of the car by riveting to the center sills, to the end posts and to the lower chords and vertical members of the stainless-steel end trusses. No rivets other than these are used in the structure. The greater part of the bending moment due to the eccentric loading at the center pin is resisted by compression loading in the roof and the remainder by a bending stress in the center sills. The end posts are built-up of ⅛-in. stainless-steel plates and are 12 in. deep.

Unlike the stainless-steel cars previously built by the Budd company, the sheathing on the Burlington train is not all of the fluted type adopted to prevent the formation of shear lines and other weaves which would develop in the 0.020-in. sheets. Uncorrugated sheets of stainless steel are used around the curved surfaces at the front and rear ends of the train, on the curved roof at the rear end, and on the roof over the engine room.



The Winton eight-cylinder, two-cycle Diesel engine

Except on the front end, where plates are ⅛ in. thick, the material is 0.030 in. in thickness.

The deadlight panels are also finished with smooth surfaces. These panels are of Armorply, furnished by the U. S. Plywood Company, in which the outside surface of the plywood is covered with stainless steel and the inside with copper to prevent warping. These panels, some of which are of unusual length, are flexibly mounted in channels at the top and bottom, in which they are sealed with a plastic calking material. Below the window rail are mounted the customary fluted side sheets.

The space below the floor level is enclosed with light corrugated sheathing similar to the roofing. To prevent resonance from air-borne noises and direct concussions this sheathing is insulated with hair felt placed between two layers of 80-lb. Craft paper, the outer of which is cemented to the sheathing.

The walls and roofs of the cars are insulated throughout with Alfol, 128 lb. of which were required for the train.

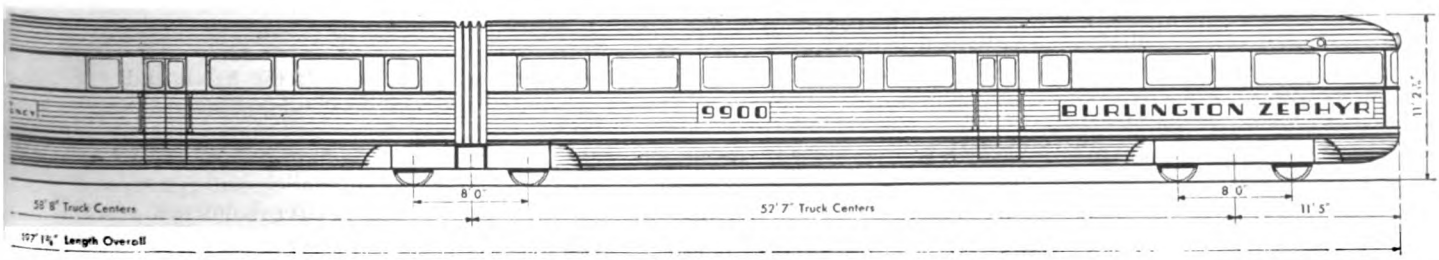
Interior Finish, Fixtures, Etc.

In the passenger compartments the side walls are finished with Masonite panels. The headlining is of Agasote. The walls of the baggage rooms are finished with galvanized sheets. The floors are laid with 5/16-in. cork tiling cemented over the corrugated steel and cork filler in the recesses of the corrugations. In the mail compartment 1-in. maple flooring is laid over the cork. In the baggage compartment a layer of roofing paper is placed between the cork and the maple flooring.

All doors, when closed, form unbroken surfaces with the outside sheathing of the car. The side doors in the two baggage compartments and in the railway postoffice are of the sliding type. They are guided in top and bottom tracks so shaped as to move the door outwards into its flush position in the door opening when it is closed.

Vestibule passages between the car bodies are enclosed by diaphragms bolted to the ends of the cars. The foot plate is formed by an approximately semi-circular plate, its straight edge secured to the end of one car and the circular edge enclosed in a horizontal recess in the end of the opposite car within which it is free to slide when the cars pass over curved track. To provide continuity of the outer surfaces accordian type diaphragms are attached between the ends of adjoining cars.

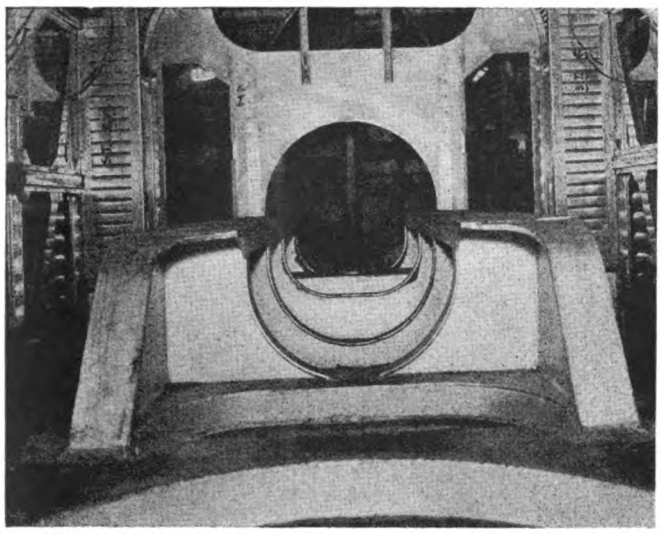
The safety window glass, supplied by the Pittsburgh Plate Glass Company, is 15 per cent lighter than the standard safety plate glass and much stronger. Generally speaking, the weight of safety glass is in the glass and the strength is in the plastic sheeting. Therefore, the thickness of the plate glass for this special lamin-



of the Burlington Zephyr

ated product was reduced from 7/64 in. to 0.09 in., and the thickness of the plastic was raised from 0.025 in. to 0.050 in. for the safety glass to be used in the rear and side windows and to 0.075 in. for the safety glass in the front windows.

Because of the type of construction it was calculated that there would be a certain amount of weaving of the coach bodies which would crack the glass under usual



The engine bed, in place, looking toward the front

glazing methods. A system was developed of setting it in dum-dum putty, a non-hardening material, which allows play but still hermetically seals the windows to permit the air-conditioning system to operate efficiently. The window sash, furnished by the O. M. Edwards Company, are set flush with the outside surfaces of the train.

The Power Plant

The power plant for driving the train, including power auxiliaries, was designed by the Winton Engine Corporation, a subsidiary of the General Motors Corporation. Power for propulsion of the train originates in a Winton high-compression, two-cycle, 8-in. by 10-in. eight-in-line Diesel engine. Power for all auxiliaries, whether driven directly or indirectly, is taken from the engine in excess of its rated output of 600 hp. at 750 r.p.m.

Incorporated in this engine are several novel features of construction and design. For example, engine weight has been reduced to about 22 lb. per hp. by the Lukenweld process for welding steel plate to form a single-piece engine block, comprising the crankcase and cylinder block, to which a light oil pan is attached. Nine steel-backed, lead-bronze-faced main bearing liners, 6½ in. in diameter, are clamped by shimless bearing caps held in place with jack screws acting against the frame arch below the cylinder block.

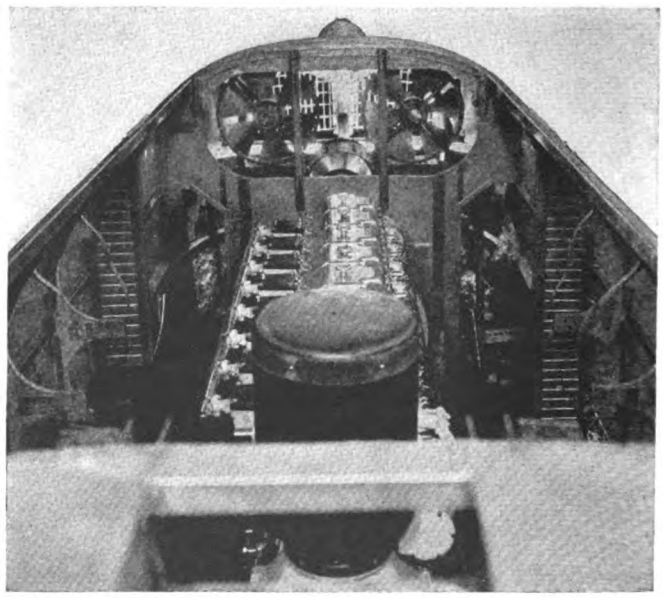
Water jacketed cylinder liners of heat-treated cast iron are bolted to the cylinder heads, which in turn are fastened in the usual manner to the cylinder block. About mid-length are cast twenty-four oblique air-intake ports circling each cylinder liner. Thus, the cylinder block forms an air-intake manifold in which pressure is maintained by a three-lobed twin-rotor scavenging blower or compressor, mounted on the front end of the engine block. This arrangement of air intake and the use of four 2¾-in. exhaust valves per cylinder insures scavenging of the cylinder at a minimum blower pressure. The heads of the aluminum alloy pistons are cooled by a stream of oil emitted from the top of special I-section connecting rods fitted with bearing liners having a 6-in. bore.

The possibilities in power economy, afforded by streamlining railroad equipment, required the remodeling of the conventional engine-cooling and exhaust systems to provide a smooth roof line. Two large engine-driven fans are mounted above the partition separating the engine room from the control cab. A grilled opening in the front of the train admits air to the fans via a duct formed by the cab ceiling and the car roof. The large volume of air brought into the engine room passes through the cooling radiators and thence outside through a central longitudinal slot in the roof.

The main generator is a single-bearing, differentially wound General Electric machine placed forward of the engine and directly connected through a flexible steel-disc coupling. A direct-connected exciter is used. A shaft extension is provided at the exciter end of the main generator to drive through V-belts a 25-kw. auxiliary generator mounted above the main generator. The opposite end of the auxiliary generator shaft is also extended for V-belt connections to the two fans which draw air into the engine room.

The two series-wound G. E. traction motors are mounted on the front truck of the leading car. They are self-ventilated by multiple fans mounted at the pinion ends of the armatures. Ventilating air is taken from the engine room through canvas ducts, and motor ventilation is aided by the slight positive air pressure—about 1 in. of water—in the engine room.

Motor control consists essentially of one master controller, electro-pneumatically operated motor contactors, and reversor, together with the necessary auxiliary magnetic contactors, switches, relays, etc. The control provides for operation from the front of the train only and for starting and stopping the engine, regulating



Looking into the engine room with the hatch and radiators removed

headlights, cab lights, etc. The traction motors are progressively connected in series, parallel and parallel-shunted-field combinations with transfer from one connection to the next higher effected manually.

The 25-kw. two-bearing 76-volt auxiliary generator is of the four-pole direct-current commutating-pole type.

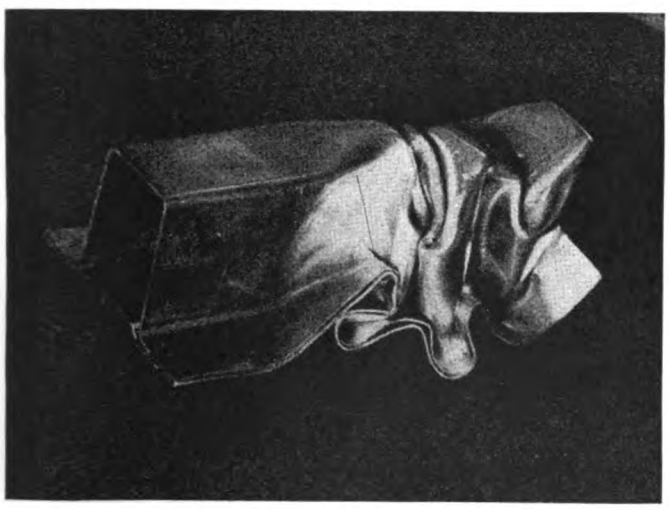
The output of the generator is furnished to the air compressors, the air-conditioning equipment, motor for train heating boiler, battery charging, lights, control, buffet utensils, etc., at a constant voltage regardless of load or engine speed.

The storage battery is an Exide Ironclad 32-cell, 64-volt battery rated at 450 amp. hr. at the 10-hr. discharge rate, which is placed in a stainless-steel battery pit in the engine room. The weight of the battery is 3,260 lb. Ventilating scoops are used to increase air circulation in the battery box. The battery is used for engine cranking in addition to supplying power to the auxiliary circuits.

Two General Electric 25-cu. ft. air compressors, driven by 76-volt motors, furnish the necessary air for the train. These compressors are of standard design, but with aluminum frame parts to obtain a light-weight equipment.

The Trucks

The four trucks are all of conventional outside bearing type of construction. All have cast-steel frames and bolsters, furnished by the General Steel Castings Corporation. Their combined weight is 55,000 lb. without



A 14-in. section of a structural member tested to destruction under compression—it withstood over 70,000 lb. per sq. in.

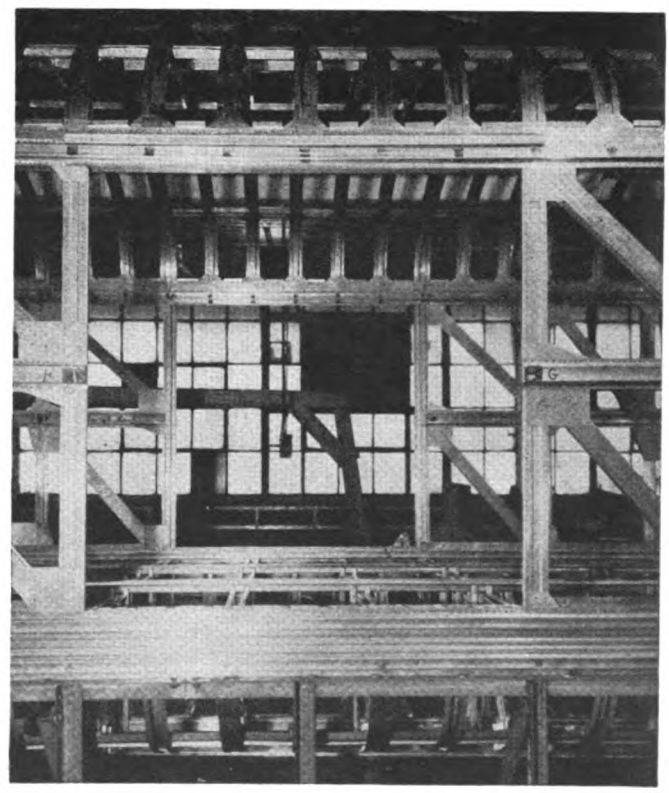
the motors and gears in the power truck. All journals are fitted with Timken roller bearings. The axles are hollow-bored to reduce weight.

Of particular interest in the construction of the trucks is the extensive use of rubber insulation to prevent the transmission of sound and other high-frequency vibrations to the car bodies. There are inserts under the center plate, in both top and bottom equalizer spring seats and between the ends of the equalizers and journal boxes. Rubber liners in the pedestals are faced with Oilite metal plates, vulcanized on, which serve as bearing surfaces for the faces and flanges of the boxes. The bolster pads, which insulate the bolster from the truck frame, are also faced with Oilite metal. In addition to the pad under the center plate, rubber thimbles are provided around the king pin and the center-plate bolts, the latter also including washers. A further precaution against unnecessary noise is the provision of automotive brake lining wherever the members of the truck brake rigging are likely to rub. To dampen vibrations of lower frequency Holland helical-volute springs are used on the equalizers of all four trucks. These springs consist of the conventional helical outer coil with an inner volute spring in place of the inner helical coil. The center plate bearing, the bearing between the articulation castings and side bearings are all faced with Oilite.

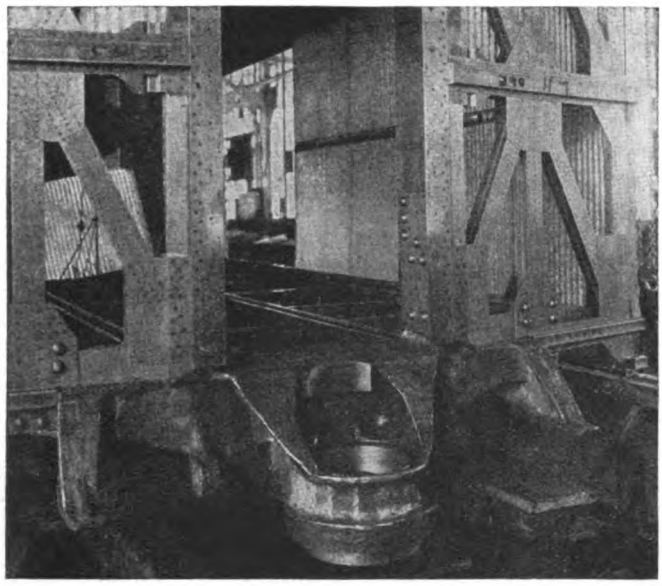
Brakes

The train is fitted with Westinghouse SME-3 brake equipment, which has been modified specifically for high-speed articulated train units. This is a straight-air system with emergency feature and also has a brake pipe which permits standard automatic operation of the brakes in case it should be necessary or desirable to move this train in connection with steam-train equipment. There are three air lines on the train: (1) The emergency pipe through which the supply reservoirs for each vehicle are charged at all times under normal operation and the loss of pressure from which causes the control valves to effect an emergency application of the brakes; (2) the straight-air pipe, pressure variations in which cause the control valves to effect graduated service application and release, and (3) the brake pipe by means of which automatic operation of the brakes can be effected when the articulated train is moving in connection with steam-train equipment or when backing up and on which the conductor's valve in the rear car is placed.

The brake valve operates the brakes by controlling the pressure in the straight-air pipe. It is self-lapping, the degree of service application varying with the position of the handle, a feature by which great sensitivity is attained. The dead-man control is operated either pneumatically by a foot pedal or electro-pneumatically by a push-button on the brake-valve handle. The release of both of these automatically cuts off the power and causes an emergency application of the brakes. The brake valve also provides, electro-pneumatically, for an emergency application of the brakes should a failure of pressure in the straight-air pipe prevent a response to a movement of the brake valve to service application position within a predetermined time interval.



The carlines are closely spaced over the door openings



The end frame and articulation casting—The Shotwelds are clearly visible

In order to effect the high rates of retardation required to keep stopping distances from speeds of 100 or more miles per hour within present limits, the brake system is designed for a 200-per cent braking ratio at 100 lb. cylinder pressure. Because of the increasing coefficient of brake-shoe friction as the speed is reduced, the brake-cylinder pressure is controlled automatically as the train slows down by a retardation controller, a pendulum inertia device by which brake-cylinder pressure is reduced at a rate sufficient to maintain a constant predetermined retardation rate. The retardation controller is wired in the battery circuit to solenoids on the control valves and through these the control of brake-cylinder pressure is effected.

Aluminum has been used extensively in the air-brake equipment in the interest of weight reduction. This includes the control-valves and brake cylinders, etc. The supply reservoirs are of light-gage stainless steel.

The Heating System

The train is equipped with steam heat throughout. Each passenger compartment also has its own mechanical air-conditioning system. These are interlocked with the heating system so that the force-ventilation feature of the air-conditioning equipment is available both winter and summer.

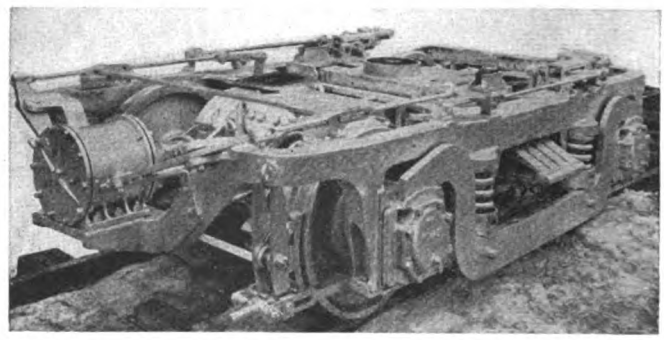
Steam for heating is provided by an oil-fired Peter Smith boiler with an evaporative capacity of 500 lb. per hour at a pressure of 85 lb., furnished by the Vapor Car Heating Company. This boiler is located at the rear end of the baggage room in the second car. Its operation is completely automatic and, in order to reduce weight, the condensate from the radiators is returned to the 50-gal. feedwater storage tank. Storage is provided for 75 gal. of fuel oil.

The operation of the boiler is subject to three controls: (1) A water-level control; (2) a low-water control, and (3) a burner load control. The water-level and low-water controls are of the electrode, commonly called spark-plug, type. Current at 110 volts, furnished by a small motor-generator set, passes from the electrodes to their grounded metal container through the water. If the water drops below the end of the longest electrode, the failure of the current acts to close the oil-supply valve and stop the burner motor. A variation of the water between the ends of the intermediate and short electrodes serves to cut the feed pump in or out.

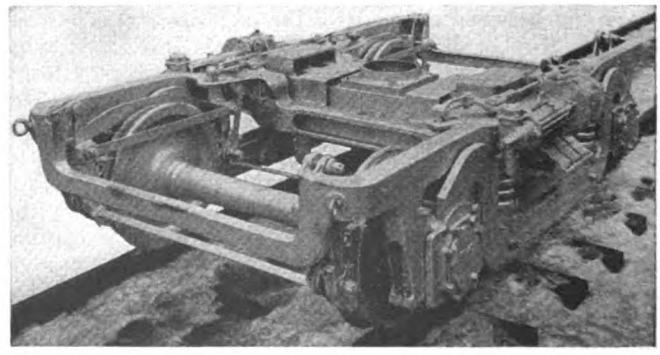
If pressure in the boiler builds up beyond a predetermined point owing to a load insufficient to utilize all of the steam being produced, a pressure switch operates automatically to reduce the flow of oil to the burner and the speed of the burner motor, thus maintaining a flame which is little more than a pilot light until such time as the reduction in pressure restores the flow of oil and the speed of the motor fan to their full-load amount.

Heat is supplied to the passenger compartments from two sources. A fin-tube coil in the evaporator unit of the air-conditioning system in each compartment supplies heat to the fresh and recirculated air passing through the units to the compartments. Steam is also supplied to a copper fin-pipe along the truss plank near the floor on each side of the compartment. The admission of steam to both radiators is controlled by motorized valves which are actuated by independent thermostats. A thermostat for the control of the air-conditioner radiators is located on a deadlight panel near the center of each compartment about 5 ft. above the floor. The thermostat for the side-wall radiators is placed near the floor and serves to bring these radiators into action automatically when the heat distribution from the air-conditioning unit is not sufficient to maintain a predetermined temperature at the floor.

A unique scheme has been developed for returning condensate from the radiators of the front and rear cars to the feedwater storage tank on the second car. Water from the radiator traps drains into small sumps, one on each of the two cars. As the water level rises in the sump, a float causes a relay to open a solenoid valve in the brake pipe, admitting air to the sump under regulated pressure and forcing the condensate through a separate return line to the storage tank. During layover periods the entire train can be heated by steam from the



The power truck

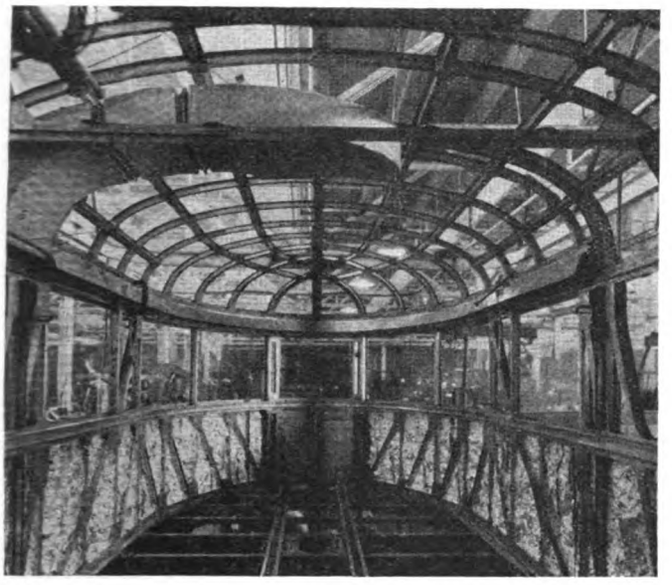


One of the trailer trucks

terminal supply. The heating and thermostatic controls are the product of the Vapor Car Heating Company.

Air Conditioning

Each of the three passenger compartments is served by a complete York mechanical air-conditioning unit of 1½ tons nominal capacity. The compressors as well as the condenser and evaporator units are all located within the underbody below the floors of the coaches. The evaporators deliver air through the grilles in the bulkheads over



Framing of the rear car—The Alfol insulation is partially applied

the center doors into the compartments. Recirculated air leaves the compartments through filter-protected openings in the floor over the evaporator units.

The motors for operating the compressors and the evaporator-unit fans were manufactured by the General Electric Company. A 7½-hp. a.c.-d.c. motor operates the two compressors and the condenser fans on the third car and a 3-hp. d.c. motor drives the compressor unit and the condenser fan on the second car. For standby service when the main power plant is not in operation a tap from a 220-volt, 60-cycle terminal supply can be plugged in to operate the a.c. motor on the rear coach. This drives the two units on this coach and the d.c. motor becomes a generator which supplies current for reduced-capacity operation of the unit on the second car. The d.c. motors operate on 76-volt current from the head-end supply. The compressor motors operate at 1,750 r.p.m. Two ¼-hp. and one ⅓-hp. motors drive the evaporator fans. The complete equipment, including the motors and controls, has a total weight of about 2,400 lb., and with refrigeration lines, water lines, electric cables, etc., included, does not exceed 3,000 lb.

Copper pipe with sweated fittings has been used throughout the train for water, steam and air. Its use has effected a piping weight reduction estimated at 60 per cent. It is scale-proof and once installed possesses a high degree of permanence. Because of the difficulty of access for replacement of some of the piping, this factor was of considerable importance.

Interior Fittings

In the smoking and passenger compartments the lighting is indirect, the lights being concealed within longitudinal ducts below the ceiling along each side of the car. The sides of these ducts toward the sides of the car are open and the light reflected from the curved inner surfaces of each duct and against the curve of the ceiling and the side of the car is diffused in a wide angle which reaches completely across the car at the reading height. The illumination on each side of the car is thus received from the lights in both conduits. The exterior of the conduit is blended into the surface of the ceiling by smooth flowing curves. The lighting is designed to produce an intensity of eight foot-candles at reading height. The lounge is lighted directly through diffusing glass which covers the underside of long ducts placed along the walls just above the windows.

The seats in the smoking and passenger compartments are built on light-weight aluminum frames. Those in the smoking compartment are upholstered in leather and those in the main passenger compartment, in Chase Velmo low-pile mohair. The backs are adjustable from the normal upright to a semi-reclining position. They are built with a clear space 18 in. high underneath for the stowing of hand baggage. All passenger compartments of the train have radio reception.

Lights

The front headlight is a 14-in., 250-watt, Golden Glow unit made by the Electric Service Supplies Company. The back-up light is a 9-in., 40-watt unit made by the same manufacturer. The marker and classification lights are Pyle-National airplane-wing lights in built-in housings.

All lights inside the car and also all auxiliary apparatus are controlled through Westinghouse Nofuze load centers. Arrow, Hart & Hegeman heater switches provide for connecting inside lights all in multiple, for using only alternate lights and for dimming the lights by connecting the two groups in series.

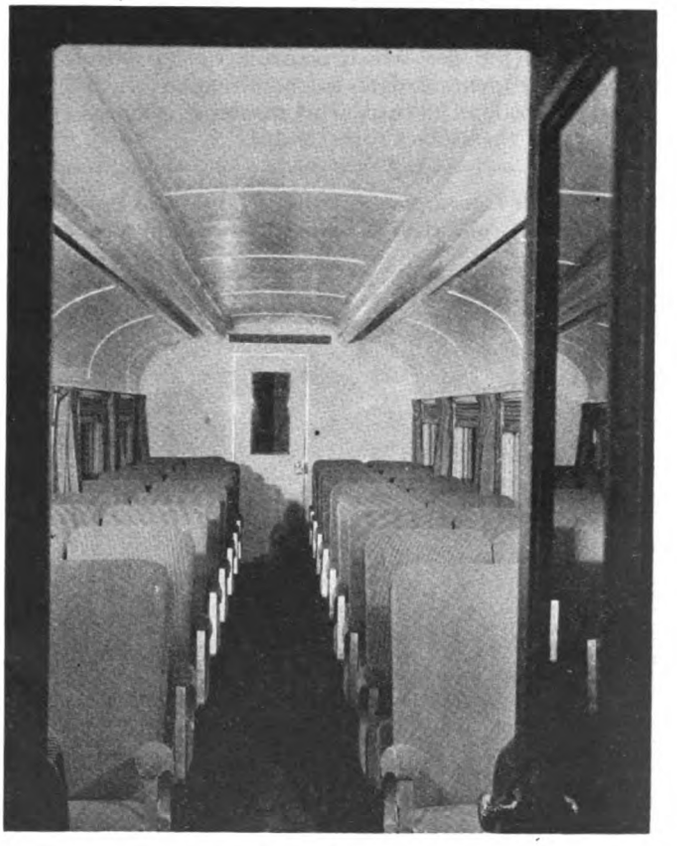


Photo by Wendell MacRae, New York

Looking toward the rear of the main passenger compartment from the smoking room—The air-conditioner grille is over the door in the bulkhead

Locomotives Inadequately Depreciated

Over half the steam locomotives are 20 or more years old —Depreciation rates indicate projected lives varying by types from 28 to over 50 years

IN personal letters to the presidents of the Class I railways, Co-ordinator Eastman, on April 24, enclosed a series of statements relating to steam locomotives, based in part on the returns to a questionnaire addressed to them on November 8, including a report by the Section of Car Pooling in which is summarized the first section of its study of the returns, dealing with description, condition, potential capacity, and programs for repair and retirement. The second section, devoted to a study of repair costs with relation to the age and size of locomotives, will follow in the near future. These studies, Mr. Eastman said, are believed to constitute the most complete summarization of steam locomotive data ever undertaken.

An accompanying memorandum by O. C. Castle, director of the Section of Car Pooling, said that from the facts it is apparent that there is ample power if adequately maintained to protect any probable increase in traffic in the near future but that this does not imply that it may not be economical or desirable to purchase new power. Calculated on a tractive power basis, the remaining mileage for all locomotives is placed at the equivalent of 34.8 per cent of the total estimated potential, and the difference between such ratio and 50 per cent, the accepted normal, is said to represent the extent of deferred maintenance. In commenting on the statements Mr. Eastman said in part:

Mr. Eastman's Comment

The value of the information developed obviously depends upon the use which is made of it. Means for applying the general data to the situation on an individual railroad, as more clearly presenting essential facts, will suggest themselves to executives.

The calculations in the attached statement were produced with the aid of tabulating machines. The punched cards used in the process are available for use in further general studies, or may be availed of by individual railroads desiring to analyze their reports on Form CP-2 and Form CP-3. My Section of Car Pooling will undertake to supervise such individual studies, providing the railroads desiring them will assume the cost of the tabulation and the extra clerical work involved. The cost of such a study should be nominal.

Respecting the results of the general study, it seems in order to comment upon a few of the interesting and important items, and to suggest some of the features which should prove of practical value at this time.

In submitting the questionnaire form, I requested those addressed to indicate their preferences or to give expression to their personal views on several subjects directly related to locomotive efficiency and operating economy. The replies are summarized. Unfortunately the value of this summary is lessened by the failure of many of those addressed to reply to the questions.

One of these questions was with respect to the most reliable unit for comparing locomotive repair costs. The statistical data on this feature of the study will appear in section two of the report, and the significance of the replies will be discussed in that section.

Depreciation Anomalies

Another question dealt with the extent to which recent studies have been made for the purpose of determining the relative economic value of certain types of locomotives. Only six of the 146 railroads addressed advised that such studies have been made within the past five years. Possibly this apparent lack of interest in a factor of such vital moment in the operation of a railroad, may throw some light upon the startling variations which appear in the depreciation calculations.

Ages; Ledger Values, Accrued Depreciation and Projected Life of Locomotives of Class I Railways, by Types

Whyte symbol	Number	Per cent service group	Age, weighted	Ledger values	Accrued depreciation	Annual rate depreciation	Years life at rate depreciated
			SWITCH				
0-6-0	5,797	65.8	23.1	$16,799	$9,504	2.45	41
0-8-0	2,821	32.1	15.2	33,090	12,001	2.39	42
0-4-0	142	1.6	24.4	12,358	8,287	2.75	36
Others*	44	0.5	...	.....	.....	...	..
Total	8,803	100.0					
			ROAD				
2-8-0	11,266	26.4	25.9	$20,543	$12,772	2.40	42
2-8-2	9,830	23.1	15.9	43,428	18,441	2.67	37
4-6-2	5,528	13.0	18.8	34,493	15,960	2.46	41
4-6-0	4,451	10.4	28.6	17,176	10,040	2.05	49
2-10-2	2,054	4.8	14.5	62,808	29,711	3.26	31
4-8-2	1,809	4.2	8.9	71,110	20,052	3.17	32
2-6-0	1,171	2.8	29.6	16,340	10,291	2.13	47
4-4-2	862	2.2	26.7	20,898	13,800	2.47	40
2-10-0	843	2.0	12.0	61,338	26,202	3.56	28
2-6-2	776	1.8	27.5	21,031	14,185	2.45	41
4-4-0	750	1.7	34.2	13,104	8,350	1.86	54
2-6-6-2	649	1.5	17.4	53,212	24,875	2.68	37
2-8-8-2	525	1.2	12.6	82,375	26,596	2.56	39
4-8-0	409	0.9	29.9	20,418	12,531	2.05	49
2-8-4	293	0.7	5.7	93,577	19,621	3.68	27
4-6-4	285	0.7	4.3	82,923	10,942	3.07	33
4-8-4	282	0.7	3.6	106,620	12,713	3.31	30
2-8-8-0	226	0.5	14.7	70,560	35,842	3.46	29
2-10-4	186	0.4	4.4	100,831	15,861	3.57	28
All others†	427	1.0	...	.....	.....	...	..
Total	42,622	100.0					
Total road and switch	51,425						

* Includes forty-two 0-10-0, one 0-12-0 and one 0-16-0.
† Includes 21 types, of which 219 locomotives are of 9 articulated types.

Steam Locomotives by Age Groups and Retirement Program, Class I Railways

Grouped by age years	Number owned Oct. 1, 1933	Per cent of total	Number to be retired by Dec. 31, 1938	Per cent of age group
0- 3	763	1.5	....	...
4- 6	1,932	3.8	....	...
7-10	6,132	11.9	1	...
11-15	6,948	13.5	44	0.6
16-20	8,052	15.7	471	5.8
21-25	9,740	18.9	1,408	14.5
26-30	11,853	23.0	2,986	25.2
31-35	4,441	8.6	1,499	33.8
36-40	606	1.2	294	48.5
41-45	712	1.4	380	53.4
46-50	180	0.4	83	46.1
51 and over....	66	0.1	46	69.7
Total	51,425	100.0	7,212	14.0

There may be good reasons for such a wide spread in the life expectancy; for example, as between the 2-10-0 type, with 28 years, and the 4-4-0 type with 54. There may be a satisfactory explanation for the fact that Southern railroads base their calculations upon a life of 98 years for the same type of locomotive which is expected to reach its limit at 47 and 48 years in the Eastern and Western districts. Such reasons and explanations are not likely to be developed, however, without a more scientific study of locomotive efficiency and obsolescence than has heretofore been devoted to the subject, if we are to rely upon the replies so far submitted. Probably one answer is that the reporting railroads do not expect to secure any such length of service as the calculations show, and that the exaggerations are due largely to the fact that depreciation charges in these cases are inadequate.

As I have previously pointed out, there is little temporary and no permanent advantage in understating depreciation, and to the extent that the practice is continued, it affects the solvency of a concern and presents a misleading picture to the security holders and the public. It is encouraging that a large proportion of the roads replying have indicated their desire to adjust these undercharges by writing off the deficiency as a charge to Profit and Loss. Such action should have a beneficial effect by expediting the retirement of those units which, through obsolescence or excessive maintenance costs, cannot be economically retained in service.

In the light of the progress made in recent years in locomotive design and in the use of mechanical power in transportation, the fact that more than half of the steam locomotives now in service are over twenty years old is worthy of serious consideration.

The two items of operating expense which are most directly affected by the age and design of motive power, locomotive repairs and fuel, together constitute a substantial proportion of the total cost of operation. I am sure that you appreciate the opportunity for economies which lies in this field of research and hope that you may find the results of our locomotive studies helpful in the analysis of your own situation.

Summary of the Study

Mr. Castle's summary follows:

The total number of steam locomotives owned by Class I Railroads, as reflected by their reports, is 51,425, averaging 20.7 years of age.

The oldest unit reported was built in 1865. The owner of this locomotive schedules it for class repairs in 1938 when it will be 73 years old.

More than 53 per cent of all locomotives, or 27,598, are 21 years or more of age. Of this number 6,696, or about one-fourth, are scheduled for retirement by the end of 1938.

On the basis of wheel arrangement there are forty-six types of locomotives, of which forty are road and six are switch types.

Seven types include 84.7 per cent of all road locomotives, and 97.9 per cent of the switch units fall under two types.

The ledger value averaged $33,402 per unit, and varied by types from $2,806 to $172,031.

The average cost per tractive-power pound is seventy cents, the variation in this cost as between districts being but 3.3 per cent.

The accrued depreciation averaged $15,136 per locomotive, equivalent to an annual rate of 2.19 per cent. Applying this rate to the average ledger value, we find the projected life of existing locomotives averages 46 years. There are wide variations in the life expectancy, indicated by the depreciation rate, as between roads and as between types. The most hardy type appears to be an 0-16-0, with a projected life of 1,111 years. Other unusual cases are 286, 167, and 100 years respectively.

During the year ending September 30, 1933, there were 10,120 steam locomotives which made no mileage. These units constitute 19.7 per cent of the total.

In a general way, the variations in the ratio of idle to total locomotives by types give some indication of degrees of absolescence or surplus. For example, the types showing ratios of idle units substantially above the average were: 4-4-0 (American) 42.9 per cent; 2-6-6-2 (Articulated) 33.7 per cent; 2-6-2 (Prairie) 33.1 per cent; 2-6-0 (Mogul) 30.6 per cent; 4-4-2 (Atlantic) 30 per cent.

Included in the idle locomotives were 2,110 units held for sale or scrap. The time these locomotives were so held averages 27.2 months. The district averages are: Eastern 22.9, Southern 28, Western 30.4. One railroad with an ownership of about 200 locomotives reported 35 per cent of its ownership stored an average of 51.6 months. The trackage occupied by these 64 locomotives

Estimated Maximum Locomotive Mileage Obtainable for 61-Day Peak

Whyte symbol	Locomotives in service August and September, 1933: Number	Number active	Avg. miles per day	Avg. miles per loco. day	Max. miles for 61-day peak: Avg. miles per day	Avg. miles per loco. day	Miles for 61-day peak from locomotives drawn from storage: No. stored serviceable	Avg. miles per day	Avg. miles per loco. day	Miles for 61-day peak from locomotives repaired: No. locos. that would be repaired	Avg. miles per day	Avg. miles per loco. day	Total miles obtainable for 61 days from all locomotives: Total locos. (excl. sale or scrap)	Avg. miles per day	Avg. miles per loco. day
									Switch						
0-6-0	5,797	3,978	217,113	54.6	316,270	79.5	577	45,946	79.6	850	57,399	67.5	5,405	419,615	77.6
0-8-0	2,821	2,242	162,598	72.5	206,581	92.1	159	14,973	94.2	403	42,207	104.7	2,804	263,720	94.0
Others	186	140	7,543	53.9	12,150	86.8	17	1,853	109.0	22	1,483	67.4	179	15,526	86.7
Total	8,803	6,360	387,253	60.9	535,001	84.1	753	62,772	83.4	1,275	101,089	79.3	8,388	698,861	83.3
									Road						
2-8-0	11,266	6,681	411,326	61.6	651,658	97.5	1,215	118,283	97.4	2,818	194,712	69.1	10,714	964,653	90.0
2-8-2	9,830	6,345	572,174	90.2	806,036	127.0	921	113,935	123.7	2,490	257,401	103.4	9,756	1,177,372	120.7
4-6-2	5,528	3,866	576,808	149.2	744,059	192.5	543	88,448	162.9	1,052	180,345	171.4	5,461	1,012,852	185.5
4-6-0	4,451	2,543	179,419	70.6	307,180	120.8	620	66,719	107.6	820	74,782	91.2	3,983	448,681	112.6
2-10-2	2,054	1,251	103,967	83.1	153,248	122.5	290	32,280	111.3	511	53,587	104.9	2,052	239,115	116.5
4-8-2	1,809	1,343	217,721	162.1	244,020	181.7	103	13,631	132.3	363	61,749	170.1	1,809	319,400	176.6
2-6-0	1,171	636	33,066	52.0	56,263	88.9	91	7,124	78.3	281	15,421	54.9	1,008	78,808	78.2
4-4-2	862	440	47,154	107.2	69,700	158.4	122	20,929	171.5	231	21,924	94.9	793	112,544	141.9
2-10-0	843	487	40,175	82.5	46,800	96.1	104	5,857	56.3	211	24,223	114.8	802	76,881	95.9
2-6-2	776	409	24,966	61.0	33,612	82.2	144	11,748	81.6	147	11,019	75.0	700	56,379	80.5
4-4-0	750	330	18,799	57.0	40,525	122.8	114	13,114	115.0	137	8,859	64.7	581	62,497	107.6
2-6-6-2	649	309	21,288	68.9	39,361	127.4	144	17,783	123.5	111	6,155	55.5	564	63,433	102.5
2-8-8-2	525	410	31,388	76.5	45,883	111.9	31	3,073	99.1	84	6,769	80.6	525	55,724	106.1
Others	2,108	1,533	226,674	147.9	267,293	174.4	198	20,828	105.2	348	60,469	173.8	2,079	348,457	167.6
Total	42,622	26,583	2,504,917	94.2	3,505,638	131.9	4,640	533,752	115.0	9,604	977,415	101.8	40,827	5,016,807	122.9
									Switch and Road						
Total	51,425	32,943	2,892,170	87.8	4,040,639	122.7	5,393	596,524	110.6	10,879	1,078,504	99.1	49,215	5,715,668	116.1

set aside for more than four years is located in a large industrial center.

Using the actual locomotive mileage made during August and September, 1933, as a basis, the railroads estimate that with an adequate preliminary repair program, they could, under conditions of peak demand, increase the total locomotive miles per day with the engines in service 39.7 per cent, and obtain from them as a maximum 122.7 miles per locomotive-day. From 5,393 locomotives to be withdrawn from storage, additional mileage equal to 20.6 per cent of the August-September actual could be secured. From the shop out-turn, the estimated mileage equals an additional 37.3 per cent, making all told, a possible increase in total locomotive-miles per day of 97.6 per cent.

The average miles per locomotive-day under the assumed conditions is, for those in service, 122.7; withdrawn from storage, 110.6; and all locomotives, 116.1.

The actual freight and passenger locomotive miles made during the peak month of October, 1929, was 3,495,188 per day. The carriers now estimate they could, under the assumed conditions, produce 5,016,807 locomotive-miles per day with road power. That is to say, they now have power sufficient to make, for a 60-day period, 43.5 per cent more locomotive-miles per day than during the peak month, October, 1929.

From these facts it is apparent that there is ample power if adequately maintained to protect any probable increase in traffic in the near future. This does not imply that it may not be economical or desirable to purchase new power. There are other factors to be reckoned with in determining this question. It is hoped that our study of Form CP-3, which will shortly be released, will have data which may be helpful in aiding the railroads to determine the economic life of motive power from the standpoint of cost of repairs.

The estimated mileage which can be secured from power when new, or between shoppings for general repairs, averages 86,380 per locomotive. By districts the averages are, Eastern 68,158; Southern 86,835; Western 105,423.

Analysis of the reports develops that on October 1, 1933, the mileage remaining in locomotives was 33.7 per cent of the estimated potential. The district averages were, Eastern 37.9 per cent; Southern 32.1 per cent; Western 31.5 per cent. Calculated on a tractive power basis, the remaining mileage for all locomotives is equivalent to 34.8 per cent of the total estimated potential. The difference between these ratios and 50 per cent, the accepted normal, represents the extent of deferred maintenance.

Diesel Locomotives

(*Continued from page 145*)

engine except on one basis. That is, that a four-cycle engine with its positive displacement of exhaust gases by the piston and its rather conventional valve mechanism may be designed almost to formula, while this is not true of the two-cycle type. In contrast, the designing of a two-cycle engine, particularly with reference to ports, shape of combustion space, i.e., the top of the piston and under side of cylinder heads, and the fuel injection mechanism, must be developed experimentally and such development obviously requires a considerable period of time, together with proper facilities and a background of experience with such engines. However, when these details have been worked out so that good combustion results and so that an engine performs to the satisfaction of a reputable builder, the operator of the engine is relieved of the responsibility for maintaining the condition and adjustment of a mechanism which does not exist on the two-cycle engine, but which is vital to the proper functioning of a four-cycle engine.

There was a time when the four-cycle engine offered the advantage of fuel consumptions from 25 to 30 per cent lower than that on the two-cycle. This condition no longer exists, as we now find many two-cycle engines with fuel consumptions below those on some four-cycle engines. However, fuel consumption is but one item in the overall cost of operation, and operating records show that this overall cost is lower for two-cycle engines.

Mr. Sawyer emphasized that all Diesels applied to locomotive service have been of the four-cycle type and that is true, at least in this country. He might have added that these engines were a product of a very few companies. Of the more than 50 builders of Diesel engines in this country only a few have felt justified up to this time in entering upon the development work required for a market, the demands of which, until very recent years, seemed uncertain and it just happens that those builders who did see fit to tackle the development were manufacturers of four-cycle engines.

The argument between advocates of two-cycle and four-cycle engines will undoubtedly continue for years to come. As evidence that this is true, within the past year, an important builder of Diesel engines in this country, who has never offered anything but four-cycle engines, brought out a line of two-cycle engines; and another large builder who has offered two-cycle Diesels exclusively, brought out a line of four-cycle.

Comments by C. E. Beck*

In 1930 Busch-Sulzer Bros. appropriated a quarter of a million dollars for railroad Diesel engine research and development work which has proceeded uninterruptedly for four years. It was necessary to approach the problem from two angles. First, we had to consider carefully what had already been developed and, second, what we were best qualified to develop. Switching Diesel locomotives up to 800 or 900 hp. have been introduced successfully by several American builders having experience exclusively in the building of engines operating on the four-stroke cycle. After due deliberation, we decided not to enter this field in order to avoid the expense of parallel development and the commercial menace of excessive competition.

Our engineering experience embraced the building of both two- and four-cycle engines, our first two-cycle engine having been built for the U. S. Navy submarine service more than 20 years ago and at the close of the World War we were building units up to 2,500 hp. for the service.

Being fully cognizant, therefore, of the relative merits of the two- and four-stroke cycle engine, we accordingly attacked the problem of sufficient reduction in size and weight of the higher power two-cycle machine to meet the requirements of heavy switching, transfer, main line passenger and freight locomotives from 1,600 hp. to 3,500 hp. capacity. These sizes were selected with anticipation of lighter passenger trains with somewhat higher speeds. It is expected that 85 per cent of all future locomotives will not exceed 3,500 hp.

With the horsepower limitations determined, we attempted to meet the following requirements: 1. Weight not to exceed 25 lb. per hp. 2. Rotative speeds around 550 to 600 r.p.m. 3. Reliability—assured by extreme simplicity, use of the best materials known, a minimum number of moving parts and elimination of the personal equation of the operator to a maximum degree.

An eight-cylinder Vee type, two-cycle engine of 1,600 hp. has been complete and is now under test.

* Sales Engineer, Busch-Sulzer Bros.-Diesel Engine Company.

Progressive Repairing of Box Cars*

By A. H. Faerber†

Description of system used by New York Central at East Buffalo car shop

THERE are many problems to be considered in connection with establishing a progressive system of freight-car repairs. Most prominent among these is the layout of the erecting shop in relation to yard tracks, fabricating departments—such as wood mill, machine shop, blacksmith shop, etc. Fortunately, the New York Central car shop at East Buffalo, N. Y., which is approximately 1,000 ft. long and 380 ft. wide, is well located in this respect, being connected with yard tracks at both ends. This makes possible the entry of cars at one end of the shop, progressing through different positions inside of shop and emerging at other end practically finished. All departments mentioned are in close proximity; in fact, they are integral parts of the shop.

Material distribution is another matter of vital importance. It is absolutely necessary that material required in the various positions be available for immediate use of workmen, as any delay in this respect would retard the movement of cars and cause confusion. Co-operation by the stores department is an important factor in the achievement of desired results, and I am happy to state that this co-operation is whole-heartedly afforded.

The supplying of material direct to cars from shop storage tracks is handled by material men. Each position has its individual material man or men, the number of men being determined by the class of material used and amount of work performed in that position.

Many difficult problems had to be solved in establishing this progressive system of house-car repairs, among which were the following: Laying out positions in proper rotation, building-up the proper force in each position to obtain the best results and desired production, timing each position to operate in harmony and prevent overlapping with the next position and elimination of lost time.

At the East Buffalo shop progressive operations are confined to three bays, each bay consisting of three tracks, only two of which are used for actual car-repair work. Each track has a capacity of 18 cars. The center track in each bay is used partly for material storage, the balance of about 80 ft. being used for repairs to side doors. All bays, with the exception of middle or old shop, are serviced by overhead cranes and necessary outlets for compressed air are located at convenient points along each track. The center bay in the south end of the shop is used for fabricating and straightening metal parts and contains the necessary machinery to do this work.

The number of tracks in use at any one time depends on the desired shop output. The system was planned with the objective of eight cars per day from each track, or a maximum daily shop production of 48 cars. The class of car and extent of repairs required is the measuring stick to govern the number of men or man-hours required in each position to complete the work so that cars can be moved to the next position at the allotted time without delay to line movement.

The same system has been employed with success on steel-underframe wood-superstructure box cars, although this class of equipment presents a more difficult problem than the all-steel box cars now being handled.

Inspection and Stripping

Due to limited storage space for crippled cars the system had to be built up with the fact in mind that there could be no absolute classification. All cars, with the exception of badly damaged or wrecked cars, are run through progressive tracks as received. Damaged cars are cut out and placed on special tracks and repairs brought up to a point where they can be placed on progressive line without retarding the movement of other cars. Men employed on preparatory work on wrecked cars are available to take the places of absentees on the progressive line.

Two assigned tracks adjacent to the stripping tracks, which are open at both ends and have a total capacity of 80, 40-ft. cars, are used for the reception of incoming cars. At this point all refuse is removed from inside of cars by laborers. Straw, paper and other combustibles are disposed of in a large incinerator, while non-combustibles, such as broken tile, plaster board, etc., are loaded in company-service gondola cars and eventually disposed of at the cleaning tracks. After the interior of the car has been cleaned out, an inspection is made of the entire car and a work card is applied covering all work to be done on the stripping tracks. A statistical report is also made up at this time showing complete physical record of each car. The principal items embodied are type and style of coupler, coupler pocket and draft gear, style of trucks, date and point of last reweighing, date built new, and other data required to supply desired information for shop and general office. After this inspection has been made the cars are ready to be placed on the stripping tracks by the shop engine. These tracks have a capacity of 57 cars.

Approximately 48 to 60 cars are stripped per day, every effort being made to have at all times 100 or more cars stripped ahead of shop requirements in order that operations may be carried on in the event of stripping, which is done in the open, being slowed down by inclement weather. Mechanics on stripping tracks work in gangs of two or four men. A rotating system of assigning work is in force at this point; the first gang to finish a car takes up the next car on the track to be stripped. Tools for the immediate use of stripping gangs are kept in the toolroom at stripping track with an attendant in charge who delivers all broken or worn-out tools to various shop departments for repairs or renewals. He is also required to lubricate all pneumatic tools in use several times daily during regular working hours. This lubrication has provided more efficient service, lower maintenance cost per tool, reduction of lost time and assurance of safer working conditions for employees.

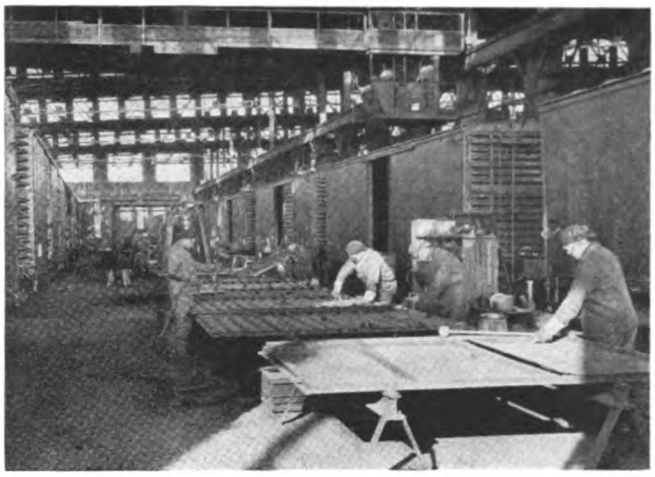
* Paper presented before the meeting of the Eastern Car Foreman's Association on January 26.

† Car shop superintendent, East Buffalo, N. Y.

All serviceable metal parts removed from the car during stripping operations are placed in racks and delivered by power trucks to fabricating departments for straightening or other repairs. Scrap wood removed from the cars is placed in suitable size piles and when accumulation warrants is loaded into gondola cars assigned to scrap wood service. This loading is done by an industrial crane equipped with wire rope slings. Periodically it is necessary to give the stripping tracks a general clean-up of all small refuse, wood chips, etc. This is raked into piles and is loaded into cars by an industrial crane equipped with clam-shell bucket. Scrap metal, such as rivet heads, small scrap castings, etc., is separated from dirt and chips and loaded with a magnet.

Sandblasting and Prime Painting

Stripped cars are next moved to sandblast and prime coat painting location, which consists of two tracks built on an incline, thus permitting cars to be moved



Preliminary work on side doors is done in space adjoining position No. 3

into sandblast frame by gravity. The sandblasting frame is 56 ft. in length with permanent side scaffolds and movable end scaffold planks.

When sandblasting has been completed, cars are advanced to another position on the same track where car cement or other matter that sand will not cut is removed with wire brushes and scrapers.

Cars are then given a thorough interior and exterior cleaning with compressed air to remove all loose sand and scale and then advanced to a position where the complete underframe is sprayed with one coat of car cement.

Interior of side sheets and steel ends are also sprayed at the bottom with the same material to approximately 18 in. from top of underframe. Exterior and interior of roof and exterior of body are sprayed with one coat of approved metal protector or paint. New steel side-door panels and new steel side sheets are sandblasted and primed before application to car. This assures the removal of mill scale, likewise all oil, grease, etc., accumulated during process of fabrication.

Men employed at sandblasting are protected by modern approved sandblast helmets which provide pure washed air. Painters, helpers and laborers employed in sandblast territory are required to wear dust respirators and goggles for protection.

Work Done in First Three Positions

After completion of sandblasting and prime painting, cars are ready to be placed on progressive line for building-up operations, starting at south end of shop.

In position No. 1 the cars are again inspected and work cards applied covering all steel work, wood framing, application of flooring, inside lining, grain strips, roof repairs and running boards. Journal-box packing is removed and loaded into drums for delivery to reclamation plant. Additional stripping, such as signboard and brake-step board brackets, loose rivets, studs, etc., which cannot consistently be removed on stripping tracks with pneumatic rivet cutters, is done at this point by acetylene burners in order to eliminate the possibility of elongated holes or other damage to steel sheets or ends. Side doors are removed from cars and delivered to door work rack for repairs necessary.

Position No. 2 is the first one inside of the shop, the cars being pulled into the shop from position No. 1 by a long cable, snatch block and overhead crane. Cars are brought into the shop in units of two on each track and are advanced in groups of two. In this position all necessary straightening is done. New or repaired metal parts—except buffer blocks and center plates—are slush painted, fitted, applied, bolted with slotted fitting bolts, holes drilled and reamed preparatory to driving rivets. Roof sheets—except complete roof—and new or repaired doors are applied. Air hose, angle cocks, brake-pipe nipples and retaining valves are removed. An overhead crane serves in this bay.

Cars are now ready to be advanced to position No. 3, but before taking up the work done in this position would call attention to the door position, which is located on the intervening track parallel to position No. 2. All doors removed from cars in this bay are brought to this point for repairs. This work is done on a table approximately 70 ft. long composed of old rails raised 25 in. from the floor on metal standards or legs. Progressive work is in force at this table. Starting at the south end where doors are stripped and straightening done, they are moved along the table to the next position for application of new or repaired parts. After they have been fitted and bolted the door is again advanced on the table for drilling and reaming.

The door is next placed on an A-shaped steel riveting frame where all rivets are driven without the necessity of again moving the door. After joints have been laid up, the door is placed on storage horses where any necessary welding is done. From this point doors are taken by overhead crane and applied.

Returning to the cars on line: In position No. 3 all body rivets, except those of buffer blocks and center plates, are now driven.

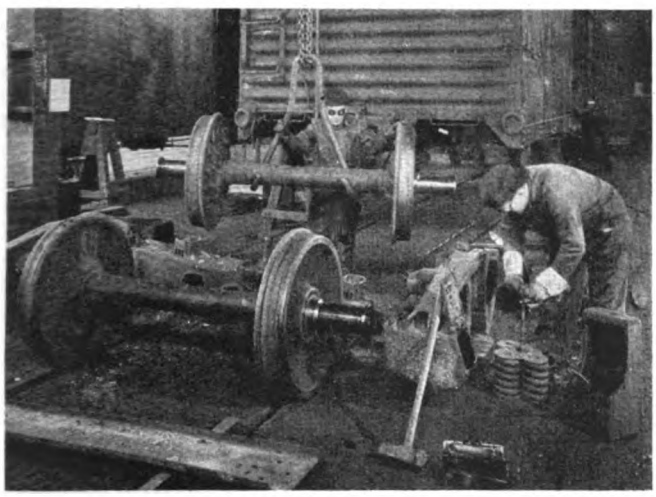
Work on Trucks, Draft Gear and Air Brakes

Repairs to trucks, couplers, draft gears and air brakes, buffer castings and center plates are performed in posi-



Riveting of doors is done on an A-shaped frame

tion No. 4. As cars are placed in this position they are gaged for coupler height and side-bearing clearance, then raised by overhead crane, placed on horses and trucks removed, this being the only point where cars are raised off of trucks while passing through the various positions. Couplers and draft gears are lowered on all cars. Trucks, couplers and draft gears are given careful inspection and a work card authorizing all work necessary is attached to the car. While car is in this position repairs are made to buffer blocks and center plates. The triple valve is removed and sent to the air-brake department for repairs and testing, brake cylinder and reservoir are removed if defective, and all brake-cylinder, reservoir and brake-pipe supporting bolts tightened or renewed. Brake cylinder and auxiliary tube are cleaned, piston or piston packing leather renewed when required, and brake cylinder lubricated. Triple valve, end nipples, angle cocks, and air hose are applied, any other defects repaired, and brake levers checked for compliance to information shown on badge plate. Floor stringers are applied, if defective, and all floor stringer bolts are tightened or renewed. After the above repairs have been completed, center plate and side bearings greased, the car is then lowered onto the



Truck work is performed in position No. 4 while cars are supported on horses

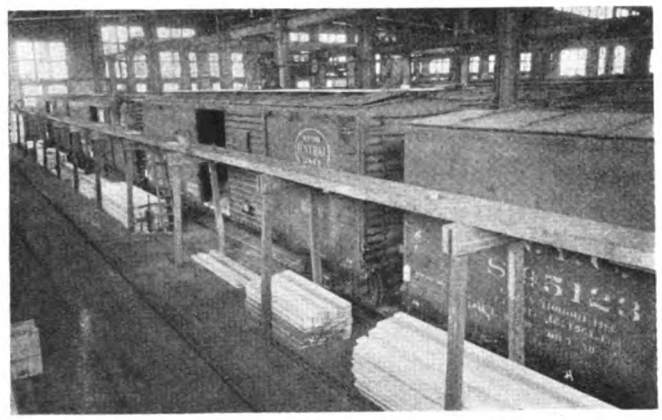
trucks. Journal boxes are repacked, after which coupler height and side-bearing clearance are again gaged and adjustments made if necessary.

Work in Later Positions

In position No. 5 safety appliances are applied, side doors fitted and made operative and door hasps fitted to door locks. Material men place required material for wood framers inside of car, except floor stringers which are applied on the truck position, and car is then moved to the next position. While on positions Nos. 5 and 6 the cars are in middle or old shop and as this shop is not equipped with an overhead crane, the cars are moved by power truck or tractor.

Position No. 6 is devoted to wood framing. All framing for door-post fillers, side-lining nailing posts, corner posts, inflammable signboards and routing card boards are attended to in this position. Touch-up prime coat painting, such as rivet heads, castings, etc., is also taken care of. The required amount of floor and end lining is now placed in the car.

Position No. 7 is devoted to the application of flooring and end lining. All flooring and end lining is cut to length and framed in the wood mill, except boring holes for floor rivets or bolts, which is done at the car.



Position No. 8 is provided with permanent scaffolds for convenience in applying roofs and running boards

Two-man gangs are employed in this position who apply flooring and end lining and bore holes for floor rivets or bolts. Annealed floor rivets are applied and riveted cold with a pneumatic riveting hammer.

Position No. 8 is devoted to application of grain strips, side lining, roofs, running boards and testing brakes. This position is equipped with permanent scaffolds for the benefit of men applying roofs and running boards. Small materials, such as bolts, nuts, washers, etc., are conveniently located on the scaffold and running boards are placed at each car by material men where they can be readily reached by workmen without leaving the scaffold. At the time running boards are applied other men are employed inside of the car applying grain strips and side lining. End of flooring at point of contact with side sheets is covered with flexible car cement and grain strips are applied on top of the wet cement. This provides a sealed joint and prevents grain or other commodity leakage. Air brakes are tested with a single car-testing device and a brake-cylinder leakage testing device. Grain strips and running boards are framed and cut to length in the wood mill before delivery to cars.

This position, on account of being equipped with scaffolds, is used when repairing cars which require complete renewal or application of all-steel or outside metal roofs. All-steel roofs are assembled on portable jigs and riveted with a gap riveter. Running boards are applied to the roof after it has been removed from the jib. The completely assembled roof is placed on the car by means of overhead crane and special carrier. In this operation the only work done on the scaffold is the riveting of the roof to the car body and securing running boards to end brackets. On cars equipped with outside metal roof the roof sheets and other roof parts are placed on scaffolds by material men so that the roof can be applied readily.

After cars are finished in this position they are pulled out of the shop at the north end with a power truck.

In position No. 9 the cars receive a second coat of paint and a third coat after a lapse of three or four hours, weather permitting. This is made possible by the use of approved fast-drying paints. All paint is applied by spraying machines. After working hours all cars on which painting has been completed are taken by the shop engine to the scale track and reweighed. Cars are then placed on the delivery track where they are stencilled the following day.

All nails inside of car are set $\frac{1}{8}$ in. below surface. Cars are given a final inspection, particular attention being paid to journal-box packing and safety appliances. Air and hand brakes are then given a final test.

EDITORIALS

Car Construction— A Field for Welding

The latest contribution to the development of passenger equipment is a train designed to operate at high speeds which is of unusual interest to the car designer because of the low weight of the complete train. This light weight was obtained by the extensive use of high-tensile stainless steel in thin sheets and formed sections. The employment of such material was made possible by a highly developed process of spot welding in which the duration of time and intensity of the electric current is accurately governed to prevent overheating of the metal surrounding the weld.

In several European countries — noticeably Great Britain, Holland, Italy and Germany—welding is now extensively employed as a substitute for riveting in building up passenger-car bodies and trucks. Here, also, a saving in weight was a very important, if not the controlling, factor in the selection of the process. Welding not only saves the weight of rivets and laps, but also permits the use of thinner sheets and sections because they are not weakened by holes for rivets. On a number of European railroads welding has been placed on what is practically a production basis and low costs have been obtained. This has been secured by the development of many ingenious jigs and devices for assembling, holding and clamping the various pieces while they are being welded together. A good example of the means employed is the rotating jig or frame for welding up the bodies of the high-speed, Diesel-electric cars for the Netherlands Railways illustrated in the *Railway Mechanical Engineer*, April, 1934.

Welding has been employed in a limited and experimental way in this country for the fabrication of freight cars and several all-welded cars have been built. Had it not been for the practical cessation of car building for the past few years, other cars of similar character would doubtless have been constructed. With an increased activity in car construction it would seem as though attention should be given to a consideration of what may be found to be a very important field for welding in such work.

What Kind of Locomotive-Miles?

On April 24 Co-ordinator Eastman sent out to the presidents of the Class I railways the report of the Section of Car Pooling on the first part of its study of the returns on the questionnaire dealing with the motive-power situation. In the summary of the report O. C. Castle, director of the Section of Car Pooling, after discussing the facts developed by the study of steam locomotive utilization, concludes that "there is ample power, if adequately maintained, to protect any probable increase in traffic in the near future." He points out, however, that "this does not imply that it may not be economical or desirable to purchase new power," and calls attention to further information developed in a study of form CP-3 to be made available shortly that may be helpful in aiding the railroads to determine the economic life of motive power from the standpoint of cost of repairs.

In the meantime it may be worth while to analyze the sources of the additional locomotive miles which, according to the estimates of the railways, can be obtained by a full-capacity utilization of all motive power during a two-months' peak period, to see whether these miles are relatively of the same value as the miles actually made during August and September, 1933, the months chosen as the base period for the study.

The carriers' estimate of the maximum mileage possible during this period is based on the assumption of a two-months' double-shift operation of all repair facilities prior to and extending through the 61-day period of assumed maximum demand. It entails the increased mileage obtainable from the locomotives actually in service on October 1, the mileage obtainable from the locomotives stored serviceable as of October 1, and the mileage obtainable from the bad-order locomotives to be restored to service under the assumed conditions.

Obsolete Locomotives Do Their Part

On another page in this issue, in the summary of the report, are presented the results of this study. Considering road locomotives only, 26,583 locomotives out of a total ownership of 42,622 were in operation on October 1 and produced an average daily mileage of 2,505,000. By an increase in miles per locomotive per day these same locomotives are considered capable of making a daily average of 3,506,000 miles during the 61-day period of peak demand. By withdrawing 4,640 locomotives from storage an additional daily mileage of 534,000 is obtainable, and by repairing 9,604 locomotives 977,000 additional miles per day are secured. In this way a maximum daily mileage of 5,017,000 is arrived at.

There are six types of locomotives which, as a whole, may be considered obsolete. These are the Consolidation, 10-wheel, Mogul, Atlantic, Prairie and American types. The Consolidation type is still by far the largest single group of locomotives in the inventory. As a whole, this type averages 25.9 years of age, and the others mentioned vary from an average of over 26 years to over 30 years of age. There are 19,276 locomotives of these six types, or about 45 per cent of all the road locomotives owned. On October 1, 11,039 of these locomotives were in service, of which 6,681 were Consolidation type locomotives. These 11,039 locomotives were 41 per cent of the total number of road engines in service. They averaged 715,000 miles per day, or only 28.5 per cent of the total daily locomotive mileage made during that period. It is estimated by the railroads that these same 11,039 locomotives could be made to deliver 1,159,000 locomotive-miles daily, or 33 per cent of the peak daily mileage obtainable from the 26,583 locomotives in active service on October 1.

The locomotives of the six obsolete types to be withdrawn from storage number 2,606, or 56 per cent of all withdrawals from storage and are to be called upon to produce 238,000 miles per day, or nearly 45 per cent of the total daily locomotive mileage to be secured from stored locomotives.

Of the total number of locomotives to be repaired under the assumed conditions, 4,434, or 46 per cent, belong to these six types of power and are expected to produce a daily average of 327,000 miles, or about one third of the total to be obtained from repaired motive power.

Adding the mileage to be obtained from all sources, approximately 1,100,000 miles of the total daily increase of 2,512,000 miles more than were made during August and September, or about 43 per cent, are to be obtained from these six types. Of the total peak mileage of 5,017,000, these obsolete types are expected to furnish 1,724,000, or over 34 per cent. These figures show clearly how heavily the railways are leaning on their oldest and most obsolete power in this estimate of maximum capacity.

The Contribution of Modern Power

In the utilization study only those types which include over one per cent of the locomotive inventory are given separate listings. All of the locomotives of the most modern types—those with four-wheel trailer trucks, of which there are 1,272—are included in a group of 2,108 locomotives designated in the table as "Others." A comparison of the actual and the estimated peak performance of this group with the actual and estimated peak performance of the Consolidation type, throws further light on the value of the increased locomotive mileage by which the peak performance is to be made possible. In August and September, 1,533 of the 2,108 locomotives in the "Others" group made 227,000 miles daily—9 per cent of the total. For the two months' peak the same locomotives are considered capable of a maximum of 267,000 miles per day. By withdrawing 198 of these locomotives from storage and repairing 348 of them, 81,000 miles are added, making a total for the peak period of 348,000 miles from this group. This is only 7 per cent of the total daily mileage obtainable during the peak period.

The 6,681 Consolidation type locomotives in service on October 1 averaged a daily mileage of 411,000 during August and September—16.4 per cent of the total. By more intensive utilization these locomotives are considered capable of producing 652,000 miles a day, an increase of more than 50 per cent. By withdrawing 1,215 from storage and repairing, 2,818 more of them 313,000 more miles could be secured from this group, making a total of 965,000 miles, or over 19 per cent of the five-million peak. In other words, while it is possible to secure from the group of locomotives within which all of the most modern power is included an increase of but 53 per cent from the total daily mileage made during August and September, the Consolidation type locomotives will contribute an increase of 134 per cent over their August and September service.

It is evident that the railroads have been making such intensive use of their modern motive power, the supply of which is small at best, that there is relatively little reserve capacity for an extensive increase in demand. It is also evident that unless 40 per cent of the contemplated increase in locomotive mileage demand is to take place on branch lines and in other light services, in which some use of locomotives of the Consolidation, 10-wheel, Mogul, Prairie and American types can be made, no such increase as estimated can practicably be handled with the present locomotive inventory. What the effect on the cost of maintenance of repairing over 2,800 Consolidation type locomotives alone and 4,400 locomotives of the six old types combined is another question. On that the further report from the Section of Car Pooling will, no doubt, shed much light.

Paint-Shop Problems

If the damaging effects of time and the elements on railway equipment are to be checked and kept within reasonable limits, the railways will have to purchase and apply more paint-protective materials in 1934 than they did in 1933. While freight equipment is doubtless in need of the most attention as regards painting, the exterior finish of passenger equipment also has been allowed to deteriorate and the following list of questions pertaining to passenger-car paint-shop operations indicates the kind of problems which now confront paint-shop foremen and supervisors. What type of primer can be used which will adhere to aluminum metal car surfaces from 8 to 10 years, as does the primer now in use for similar steel surfaces? What system of painting wooden sash will give a service life from general shopping to general shopping without repainting while the cars are in service? What method can be developed by which glass in passenger-car sash may be cleaned more economically after the sash are painted than by the present relatively slow, hand method?

Other questions pertaining to details of paint-shop operations and methods of procedure are, for example: What mechanical rubbing device can be used to eliminate hand rubbing and sanding on varnishes and surfaces, etc., and produce satisfactory results? What is the most efficient method of exhausting the spray mist from the interiors of passenger cars when applying paints and varnishes with a spray gun? What method or materials may be used for removing paint economically from Agasote ceilings or headlinings of passenger cars without injury to the material, varnish removers, sandblasting, burning with a torch, and other methods, having proved too expensive or otherwise impractical? What method of lettering may be satisfactorily used, with particular reference to the spraying of "Gold Size Japan" before laying gold leaf? What is the most serviceable and economical finish for the passenger-car exteriors, lacquer or the new synthetic finishes? What finish can be developed and used for wooden floors and passenger cars and give a greater service life than the materials now generally in use? Are the glazing, composition and surfacers now generally used on the exteriors of passenger cars as fillers likely to add to or detract from the life of the whole paint film; or would a more serviceable and economical finish be obtained by eliminating both the surfacer and the glazing composition?

Why Handicap Good Machines With Poor Tools?

Railroad shops are quite frequently the object of criticism because of the fact that they are equipped with so many machine tools that are not capable of turning out work as rapidly and efficiently as could be done with up-to-date machines. This criticism is serious enough in itself, but no more so than the numerous instances that are to be found where a modern machine is purchased and installed and the railroad fails to get out of the machine the work of which it is capable.

The primary objective of installing a new machine tool is to produce better workmanship at a saving in time and cost. There have been many cases where new machines have been purchased without accomplishing

this desired objective and, in most instances, the purchaser is liable to feel that the new machine has been a poor investment, whereas if a careful study were to be made of all of the factors involved it might be discovered that the real reason for the unsatisfactory output is poor tools. Tools—the right tools—plus a good machine are the best assurance of maximum output and high-grade workmanship.

Generally speaking, there are four factors which have a tremendous influence on the problem of tools for metal-working machinery—the proper tool steel, correct heat treatment, accurate grinding and an adequate supply of tools at the machine.

In considering the question of tool steel it is just as important to know what kind of tool steel is best adapted to a specific job as it is to know which is the best grade of tool steel. Many railroad shops are open to severe criticism for permitting the question of price to enter into the selection of tool steel. In one recent instance a railroad saved less than one dollar a pound on tool steel for a certain machine and this small saving was responsible for a loss of over seven hundred dollars in labor—in this case, almost exactly the interest on the investment in the machine involved. So, it is vitally important that, first, the proper kind of steel be selected for the job in hand and, second, that the best quality of steel of that kind be purchased. Exhaustive tests, a comprehensive investigation of practices in other shops and the advice of reputable manufacturers will go a long way toward eliminating the losses due to the use of improper tool steels.

Heat treatment plays a most important part in assuring maximum and efficient tool service. This problem gives rise to the question as to whether it is more economical for a railroad to purchase its metal-working tools already heat treated, or to perform this work in its own shops. Before attempting to answer this question it must be recognized that the best tool steel made, if improperly heat treated, is certain to render unsatisfactory service and that proper heat treatment is an exact science requiring adequate facilities, trained workmen and a wealth of experience. It is logical, then, to assume that, for roads with small shops at least, it would not pay to build up an elaborate heat-treating department, but that it would save the company money if tools were purchased, ready to use, from reputable manufacturers. This would, at least, simplify the problem of fixing the responsibility for poor tools. For the larger shops, if it is considered advisable to prepare their own tools, the best in heat-treating equipment is none too expensive. In this connection modern electric heat-treating furnaces, with automatic temperature control, meet the requirements of this exacting service in an admirable manner.

It is to be admitted that many of our older machine hands take a great deal of pride in their ability to grind tools by hand, but experience has proved that the best of them cannot equal the precision of modern tool-grinding equipment. Many of the machine operations encountered in every-day railroad shop work are of a type in which the difference between a tool properly ground and one improperly ground represents the difference between success and failure—and tool failures on big machines cost real money. On wheel turning, for example, tool steel that cannot stand punishment is a definite production handicap, but the finest tool steel made will not stand up if the tool is not ground with the proper contour and clearance. Better machine performance will result if tools are ground to a standard by the proper tool-room equipment and supplied to machine operators in such quantities as will make it unnecessary at any time for a mechanic to shut down an expensive machine to grind tools or to lose time because the tools supplied him are short lived.

Are you handicapping your machines by using poor tools?

NEW BOOKS

DARDELET THREAD HANDBOOK. *Published by the Dardelet Threadlock Corporation, 120 Broadway, New York. 220 pages, 4½ in. by 7 in. Price, $2.*

This handbook, for engineers, designers and mechanics, contains both theoretical and practical information relative to the Dardelet thread, other thread forms and thread-locking devices. There are chapters on Theory and Design, Tests, Dimensions and Specifications, External and Internal Dardelet Thread Forming, Heat Treatment, Plating, Applications of the Dardelet Self-Locking Screw Thread, etc. The purpose of the Dardelet Self-Locking Screw Thread is to provide an improved screw coupling, such as a bolt and nut, which permits ready assembly and disassembly of the co-acting threads by a relative turning movement effected by a wrench or other suitable tool, but prevents accidental unscrewing.

PROCEEDINGS OF THE INTERNATIONAL RAILWAY FUEL ASSOCIATION, 1933. *T. Duff Smith, secretary, 1660 Old Colony Building, Chicago. 126 pages, bound in red leather.*

The proceedings of the International Railway Fuel Association for 1933 contain the minutes of the twenty-fourth annual meeting held at the Sherman Hotel, Chicago, Friday, June 16, 1933, also seven committee reports. The report of the Committee on Front Ends, Grates and Ash Pans deals with two subjects: (1) The Cyclone Front End—the experience of the Northern Pacific with this front end, its development by the Locomotive Firebox Company, and tests of the Type C Cyclone arrester on the Soo Line, and (2) a summary of the results of a study of front-end action and tests on a front-end model recently completed by the Department of Railway Engineering of the University of Illinois. The Committee on Fuel Accounting and Statistics calls attention to certain data reflecting changed or changing conditions and the possible necessity of making at a later date rectifying provisions in the prescribed accounts. The ever-changing conditions which impel a change from time to time in ideas and standards of operations are discussed in the report of the Committee on Inspection and Preparation of Coal. The Relation of Pyrometers to Fuel Economy, the value of brick arches on present locomotive operation and grates are the topics given particular consideration in the report on Locomotive Firing Practice—Coal Section. The report of the Committee on Stationary Power Plants—Oil-Fired Power Plant Auxiliaries is on boiler-feed pumps, boiler feedwater heaters, fuel-oil pumping sets, fuel-oil heaters and oil strainers. A brief summary of the available information covering steam turbine and condensing locomotives in foreign countries is given in the report of the Committee on Steam Turbine and Condensing Locomotives. This is followed by a more complete discussion of the development of this type of equipment in America, with drawings showing the general arrangement and the detailed parts of condensing locomotives.

With the Car Foremen and Inspectors

Work of the Bureau of Safety*

By W. J. Patterson†

THE scope and importance of the work of the Bureau of Safety are perhaps not fully appreciated except by a comparatively few persons who are closely in touch with its various phases. A considerable number of laws and provisions are administered by this bureau.

Under the safety appliance laws standards are prescribed for equipment and devices required to be installed and maintained on cars and locomotives for safety in operating trains and switching cars; the administration of these laws has effected a material reduction in occupational hazards of employment in railroad train service and has been of vast benefit to millions of railroad employees.

The hours of service law limits the periods on duty, and prescribes necessary off-duty periods for rest, of train-service employees, operators and dispatchers. Cases of excess service by employees of these classes has been reduced from considerably more than 300,000 in 1913 to only slightly more than 3,000 in 1933, thereby relieving nervous strain and greatly reducing the possibility of errors on the part of fatigued employees which lead to railroad accidents.

Under the accident investigation law thorough and impartial investigations of serious railroad accidents are conducted and reports are issued setting forth the facts and recommending preventive measures. These reports have led not only to correction of conditions which have caused accidents but the dissemination of information contained in these reports has resulted in the correction of similar practices on other roads which sooner or later would have resulted in serious accident. Furthermore, the fact that such investigations are conducted has had a salutary effect in relieving any suggestion that blame has been unjustly placed in determining the causes of accidents which are due to circumstances or conditions beyond the control of employees directly involved, or that important information concerning such accidents, in which the public is vitally interested, is being suppressed.

The Bureau of Safety administers orders issued under section 26 of the Interstate Commerce Act, requiring installations on certain railroads of automatic train stop, train control and cab signal devices. At the time of this enactment serious railroad accidents of the type that these devices were designed to prevent were all too frequent; this condition has now to a large extent been corrected, and it is no exaggeration to say that administration of this section of the law has been an important factor in providing increased safety in railroad travel and in reducing the number of disastrous accidents.

The bureau actively participates in investigations and experiments looking toward the development and adoption of improved railroad appliances; it examines and reports upon new inventions which are designed to promote safety of operation; it investigates instances of heroism and makes reports and recommendations upon which are based the award of medals of honor by the president of the United States.

Handling Car with Defective Safety Appliances

You are directly interested in the safety appliance law and related rules as applied to the interchange of cars. Let us see how the law operates with respect to a particular interchange movement. A proviso in section 4 of the act of April 14, 1910, reads as follows:

"*Provided*, That where any car shall have been properly equipped, as provided in this Act and the other Acts mentioned herein, and such equipment shall have become defective or insecure while such car was being used by such carrier upon its line of railroad, such car may be hauled from the place where such equipment was first discovered to be defective or insecure to the nearest available point where such car can be repaired, without liability for the penalties imposed by section four of this Act or section six of the Act of March 2, 1893, as amended by the Act of April 1, 1896, if such movement is necessary to make such repairs and such repairs cannot be made except at such repair point; and such movement or hauling of such car shall be at the sole risk of the carrier, and nothing in this section shall be construed to relieve such carrier from liability in any remedial action for the death or injury of any railroad employee caused to such employee by reason of or in connection with the movement or hauling of such car with equipment which is defective or insecure or which is not maintained in accordance with the requirements of this Act and the other Acts herein referred to; and nothing in this proviso shall be construed to permit the hauling of defective cars by means of chains instead of drawbars, in revenue trains or in association with other cars that are commercially used, unless such defective cars contain live stock or 'perishable' freight."

This prescribes the very limited conditions under which a car having defective safety appliance equipment may be hauled without liability for the penalty prescribed, and the following points should be noted.

1. Privilege of hauling a defective car for repairs is granted only when the car had in the first instance been properly equipped and thereafter became defective while being used.
2. It may be hauled only by the carrier upon whose line the equipment became defective.
3. It may be hauled only from the place where the defective condition was discovered to the nearest available point where car can be repaired.
4. It may be hauled only if such movement is necessary to make the required repairs and if these repairs cannot be made except at such repair point.
5. Carrier assumes entire responsibility for risk of death or injury in connection with such movement.
6. Movement of chained up cars in revenue trains is forbidden except when they contain live-stock or perishable freight.
7. Proviso relates only to the movement of a car for repair after it has been discovered to be defective and does not relieve the carrier from liability for hauling a defective car before the defect has been discovered.

It will, therefore, be seen that the law prohibits any carrier from hauling a car with defective safety appliances to an interchange track for the purpose of delivering it to a connecting line, and likewise it prohibits a receiving line from accepting and hauling a car with such defective equipment for any purpose. Therefore, to save a penalty to both carriers it is imperative that all cars be inspected and repairs made before the car starts on its journey to a connecting line. That is a simple rule and easily understood yet during the year 1933 here in Indianapolis, out of a total of 8,445 cars

* Abstract of an address at the April 2, 1934, meeting of the Indianapolis Car Inspection Association.

† Director, Bureau of Safety, Interstate Commerce Commission.

which were inspected by the Commission's inspectors when ready to move 278 or 3.4 per cent were defective and should have been repaired before discovered by our men. During this period several cars were actually moved in and about Indianapolis in violation of law under the observation of our inspectors.

The U. S. Circuit Court of Appeals for the Sixth Circuit summed up the situation well when it said:

"We find nothing either in the safety appliance acts or in any rule of the common law which requires a carrier to accept from a connecting line a car equipped in violation of the safety appliance act; and we are of opinion that it is both the right and duty of a carrier to refuse to accept such defective car in interchange when such acceptance would necessarily involve its own use of such car in violation of these acts." (Sanford, J., May 18, 1917, 242 Fed. 420.)

Movement of Trains with Brakes Inoperative

There is another provision with respect to the movement of a train; I mean the movement of any cut of cars upon which the air brakes are required by law to be used and operated. The provision which has the effect of law is contained in an order of the Commission dated June 6, 1910, and reads as follows:

"It is ordered, That on and after September 1, 1910, on all railroads used in interstate commerce, whenever, as required by the safety appliance act as amended March 2, 1903, any train is operated with power or train brakes, not less than 85 per cent of the cars of such train shall have their brakes used and operated by the engineer of the locomotive drawing such train, and all power-brake cars in every such train which are associated together with the 85 per cent shall have their brakes so used and operated."

This prohibits transfer or other trains from running along the road or between yards unless all the cars equipped with air brakes that are associated together have their brakes used and operated. *Any cars that have inoperative brakes must be switched to the rear.*

In order that the railroads and the commission may keep informed with respect to cars that have operative brakes and those having inoperative brakes, the Bureau of Safety and the A. R. A. agreed in 1925 upon the following rule:

"42. At point where motive power or engine crew or train crew is changed, tests of the train brake system must be made as follows: After the brake system on a freight train is charged to not less than 5 lb. below the standard pressure for that train, and on a passenger train to at least 70 lb., a 15-lb. service reduction must be made upon proper request or signal, brake pipe leakage noted as indicated by the brake pipe gage (which must not exceed 7 lb. per minute), after which the reduction must be increased to 20 lb. Then an examination of the train brakes must be made to determine if brakes are applied in service application on each car. When this examination has been completed, proper release signal must be given and each brake examined to see that it releases properly."

Cars picked up en route are treated under the following rule:

"43. When one or more cars are added to a train at any point subsequent to a terminal test the cars added, when in the position where they are to be hauled in the train, must be tested as prescribed in rule 42. Before proceeding, it must be known that the brake pipe pressure is being restored as indicated by the caboose gage and that the rear brakes are released. In the absence of a caboose gage, a test must be made as prescribed in rule 40."

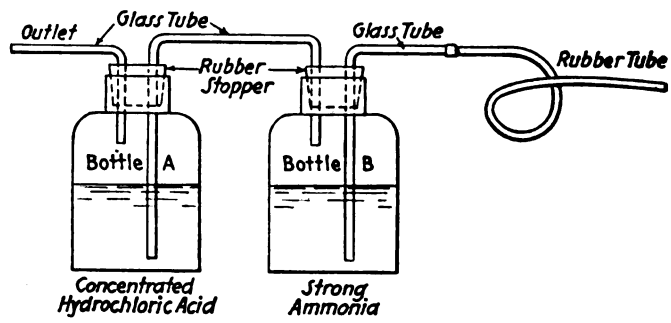
This procedure seems to be simple and easy of enforcement and observance, yet we find in this terminal the order referred to is constantly being violated, subjecting the carrier which violates it or the one that permits it to be violated to a statutory penalty of 100 dollars for each instance; this condition frequently results not so much because the law and rule are misunderstood as from activities of some enterprising subordinate who is undertaking to make a favorable record. The final result is embarrassment and financial loss to the company, and at the same time his activities subject employees to dangers which the law was intended to prevent. It is a short-sighted policy to ignore the purposes of this legislation and to disregard its specific requirements merely to avoid some temporary inconvenience. Such practices are not tolerated by railroad managements when called to their attention, nor by the courts or the administrative agencies of the Government. The requirements of the law are clear and well established; there can be no valid excuse for not conforming to them.

Smoke Gun for Testing Air-Distribution

*By T. W. Wigton**

NOW that the air conditioning of passenger car equipment is here to stay, the railway electrical engineers, or at least most of them, should be interested in any new or old devices which will make their problems in this field easier to solve. This refers particularly to equipment or apparatus for determining results of an air-conditioning installation, as regards temperature changes, water-vapor content of the air, and air movement, all of which are components of what is termed "Air Conditioning."

One of the handiest, simplest and most inexpensive contrivances for determining air movement is what could be called, for lack of a better name, a "smoke gun." With this device, one can determine accurately the movement of air in a car and can see just what is taking place as regards the air stream. However, the device to be described must not be confused with an anemometer or



When the operator forces air through the rubber tube, either by blowing through it or by using a hand bulb, a dense white vapor is emitted through the outlet from bottle A—This vapor is used in tracing air currents

a Katathermometer, which measures velocities or quantities of air, but it will be found to be a handy adjunct to test equipment, nevertheless.

As the sketch shows, the device consists of two large-mouthed bottles with rubber stoppers and glass tubing bent and installed as shown. Bottle "A" contains hydrochloric acid and bottle "B" contains strong ammonia. At the point marked "X" the end of the glass tube projecting down into bottle "B," a rubber tube should be attached. When the outfit is in use, the operator blows or puffs into this tube, or an atomizer bulb may be used and the device operated by pressure of the hand. Operation by either method forces ammonia vapor into bottle "A" where it combines with the hydrochloric acid causing a dense white vapor puff to be emitted from the outlet of bottle "A."

The odor of this vapor (ammonia chloride) is not unpleasant and while it is corrosive to metals if used in large quantities the small amount required to trace air currents in a car will do no harm to the car interior.

Users of this device will find it more useful and handy than the conventional smoke bomb. After setting up the outfit, all that is necessary, to produce puffs of "smoke," is to force a bit of air into the rubber tube either by blowing or by an atomizer bulb.

After the smoke gun has been used for some time, the operator will note a white deposit formed in the outlet tube. This deposit should be kept cleaned out and not be allowed to clog the glass tube.

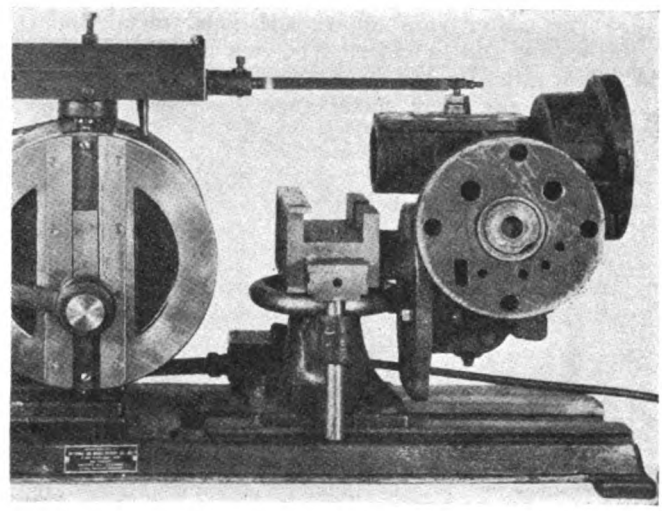
* Assistant electrical engineer, Chicago, Burlington & Quincy, Chicago.

Lapping Machine for Air-Brake Valves

THE National Air Brake Service, Inc., San Francisco, Cal., has recently placed on the market a machine to lap air-brake slide valve seats mechanically. As is well known, the maintenance of air valves is one of the most important jobs in maintaining air-brake equipment to the high standard necessary to insure safety and efficiency in train handling. The machine, illustrated, is designed to save the labor of hand broaching or lapping and thus reduce the cost and time of reconditioning air-brake valves. It is being distributed through the Pacific Railway Equipment Company, 55 New Montgomery street, San Francisco.

This machine is designed to lap locomotive distributing valves, feed valves, relief valves, and all types of triple valves, including the new "AB" type. Similar machines are said to have been successfully used for several years by one of the largest Class-I railroads, and have proved service records of performance and efficiency. One man with one machine in a western railroad shop is reported to have repaired and tested 726 triple valves in 193 hr., an average time of 15.9 min. per valve, at a cost of 21 cents each.

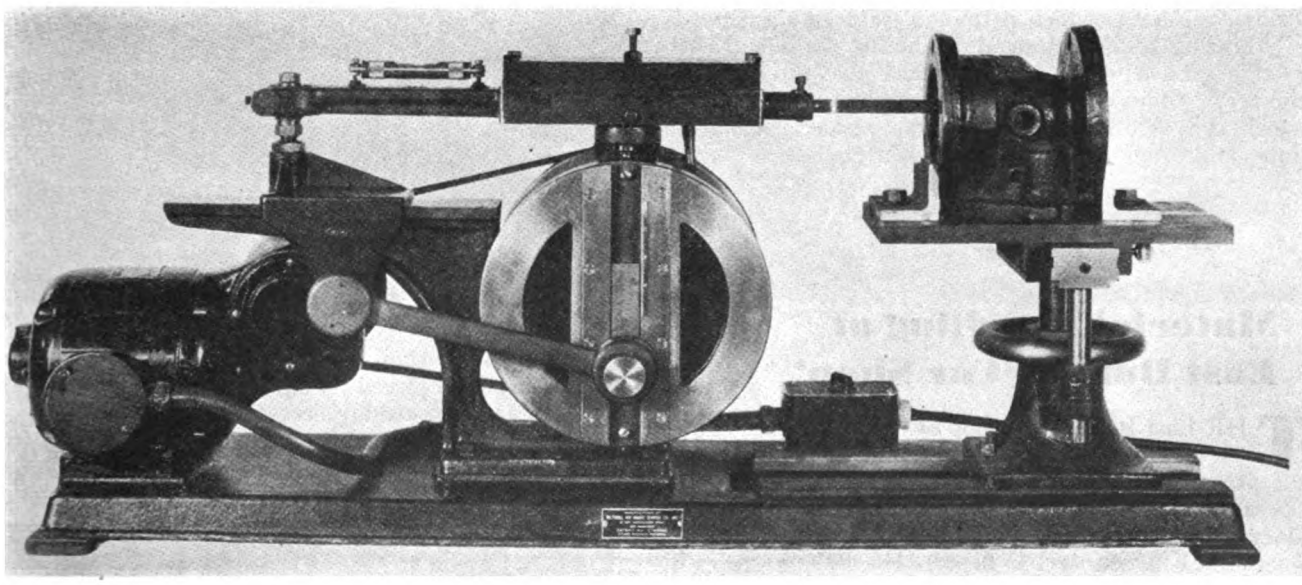
The machine consists essentially of a reciprocating arm with slotted weight in the center and a lap at the free end. The weight provides a 12-lb. downward pressure on the lap of special alloy metal, the diameter of which will vary for each type of valve. This lap rotates, is self-leveling and is grooved to handle properly the abrasive compound. The rotation is accomplished by contact with the side walls of the valve seat. When the lapping arm is running free, its weight is supported by a ball bearing in the top of an eccentric pin, the bearing surface of which is spring steel fixed in the top of the slot and which may be depressed into an inverted arc by an adjusting screw. This causes the middle of the lapping arm to move through an inverted arc and the lap to move inversely, which motion is necessary to wear down the ends of a valve seat low in the center. The eccentric pin moving in the slot and driven by a friction wheel on the inside of the fly wheel produces a lateral movement to the arm, which, in combination with the reciprocating motion, results in oscillating the lap. By disengaging the friction wheel which automatically centers the eccentric pin, a straight, horizontal movement of the lapping arm is produced and the length of stroke is adjusted between 0 and 6 in. by sliding the crank pin across the face of the fly wheel.



Close-up view showing the chuck arrangement for holding distributing valves

The machine is provided with a flat, horizontal chuck equipped with an adjustable vise to hold all types of triple valves; and a vertical, invertable chuck to hold locomotive distributing valves, feed valves, and relief valves in the necessary working position. Both chucks may be adjusted vertically, laterally and longitudinally to place the valve seats into proper relationship to the lap.

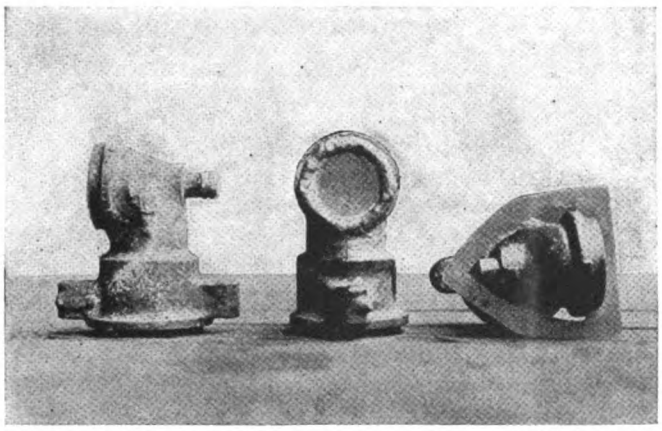
The machine is driven by a ¼-hp., 1,750 r.p.m. motor, equipped with a 10 to 1 worm reduction gear, and further speed reduction is made through a V-type belt drive to obtain a lapping arm speed of 96 strokes per min. The machine weighs 250 lb. and occupies a bench space of 13 in. by 41 in. with an overall height of 18 in.



General view of National lapping machine as used in reconditioning a triple-valve slide-valve seat

Reclaiming Metallic Steam-Hose Elbows

THE illustration shows the reclamation of metallic steam-hose elbows. The elbow at the left has been reclaimed by building up the pivot pin with bronze welding. The center view shows additional metal applied to the bearing and shoulder. The view at the right shows the elbow after it has been turned down to standard dimensions, the sheet metal gage showing the proper



Method of reclaiming metallic steam-hose elbows by building up worn parts with bronze welding

shoulder offset and the pointed end of the gage covering the proper height of the pivot pin.

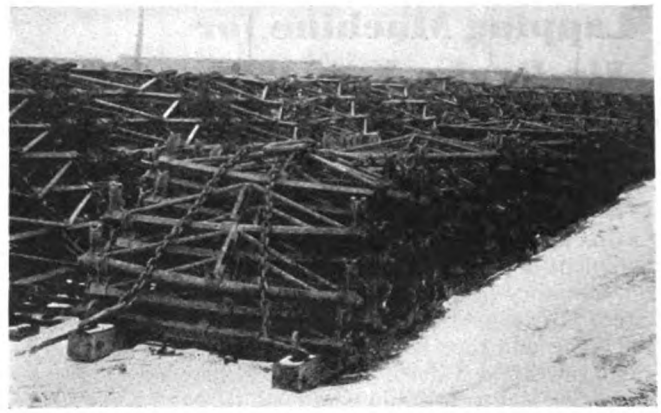
Similarly, the S-310 coupler head is repaired by: (1) Filling in the stripped threads on the pivot pin for locking the lever, which permits re-tapping the threads; (2) brazing additional metal on the lug that engages the locking groove; and (3) adding metal to the lip of the coupler. Additional metal is also applied to the shoulder which can be turned down to the proper dimensions. Supporting lugs are brazed on when cracked or broken off.

Material Handling at East Buffalo Car Shop*

THE East Buffalo car shop of the New York Central is organized for the overhauling of box cars by the progressive system of freight repairs. The effective operation of such a system is dependent in a very considerable measure upon preparation and upon close cooperation between the car department and the stores department.

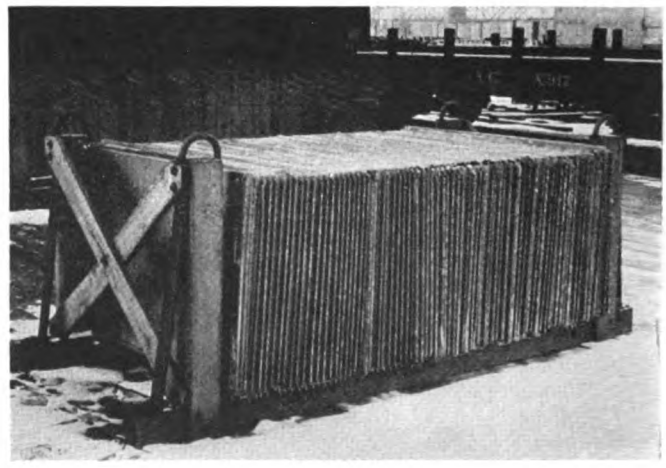
When a new repair program is being planned covering repairs to a designated number of freight cars, a number of the cars are inspected by the car department to ascertain amounts of various items of material required per car. This information is next checked with the latest drawings to determine if any changes in materials have been authorized. The stores department is then in position to prepare requisitions for the material required and orders are placed on the purchasing department with specified delivery dates. This is done to save unnecessary investments in stock and reduce duplicate handling to a minimum.

* Abstracted from a paper presented before the January meeting of the Eastern Car Foremen's Association by W. P. Hickey, district storekeeper, New York Central, East Buffalo, N. Y.



Brake beams are unloaded onto skids holding 50 beams for convenient reloading on flat cars for delivery to car shop

The shop storekeeper is in close touch with the material situation at all times and it is his duty to see that proper amounts are on hand and to supervise distribution to prevent a surplus of material at one position and a shortage at another. Much of the material is



Metal roof sheets are loaded on special skids for transfer to car shop

delivered to the shop in carload lots, unloaded by overhead cranes and placed on storage tracks in the different bays, so as to be readily accessible as required.

A few of the methods employed, together with the skids and other equipment used in the delivery of ma-



Small parts are loaded in metal boxes on skids and moved by power trucks to the point where they are to be used

terials to the shop, are of particular interest and are shown in accompanying illustrations.

Brake beams for shop use are unloaded from the car directly onto skids of special design built to hold 50 brake beams. Six of these skids are loaded onto a flat car, delivered to the shop and unloaded with an overhead crane and placed in storage adjacent to the truck position. Empty skids are then loaded on the flat car and it is returned for further loading.

Steel doors are received in carload lots, unloaded inside the shop with electric crane, stored according to type and size in convenient locations and delivered to cars by material men from this point as required.

Metal roof sheets and other roof parts are stored under cover to prevent corrosion, all roof parts being painted before they are placed in storage. As the shop requires this material roof sheets are loaded on skids, as shown, which are in turn loaded on a flat car by an overhead crane and delivered to a point in the shop adjacent to the roof position. Small roof parts are loaded in skid boxes and delivered on the same car with the roof sheets.

Rough framing lumber is unloaded from cars and piled in the lumber yard. From this point it is loaded on hand cars or lorries and delivered to the wood mill for fabrication as required. Flooring and end lining are unloaded directly into the mill from cars. After this material has been fabricated it is loaded on skids and delivered to shop storage located at or near the point of consumption. From this point it is delivered to the cars by material men. Carloads of lining are placed convenient to the locations where used and unloaded and delivered by the material men on the station direct to the job.

Small parts are usually loaded into metal boxes of suitable size which are placed on skids for ready movement by power trucks to the different points in the shop where they are required. Throughout the shop and storehouse there is every evidence of systematic planning for a movement of all materials in such a manner that they will always be close at hand as required by the different gangs of men.

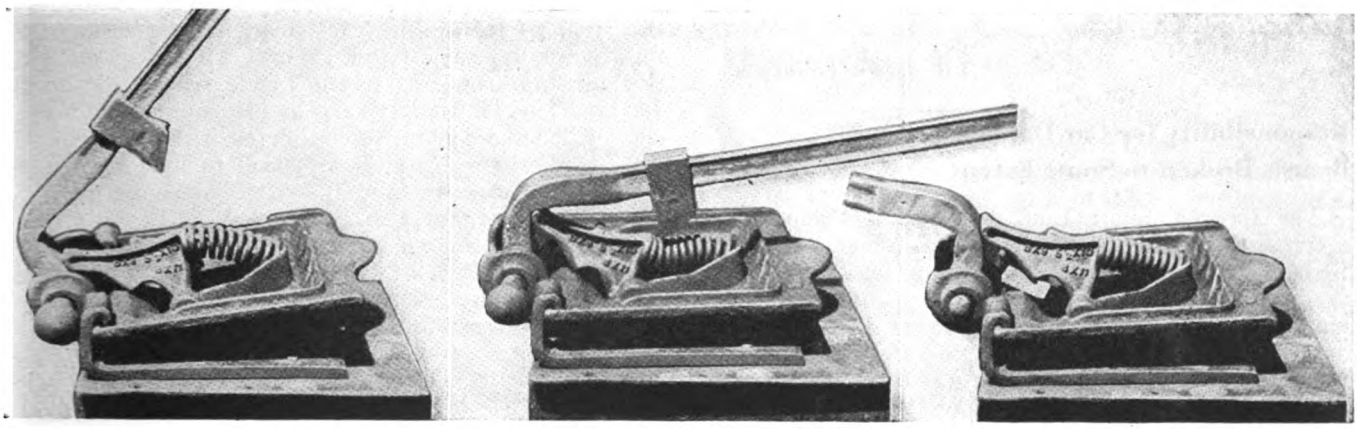
Applying Springs to Journal Box Lids

VERY often a broken coil spring or worn spring lever needs replacement in a passenger-car journal-box lid, in which case, the special tool illustrated can be used to good advantage. It can be made readily in any shop and consists simply of two strap-iron hook clamps, forged as shown in Fig. 1, and secured by screws to a board or to the top of a box, which supports the lid in a horizontal position, an offset hinged bar with sliding dog being provided for removing or applying the lid spring and lever.

To use the device, the lid is hooked under the clamps and the offset bar attached to the lid by slipping the hinge pin through a hole in the bar. In dismounting the spring, the sliding dog is moved down on the bar handle to a stop pin and the handle lowered and forced down until the dog presses on the coil spring and forces the spring lever out of the slotted bearings, as shown in Fig. 2. Removal of downward pressure on the handle and lifting it releases the coil spring and spring lever which may be readily removed.

To replace these parts, the sliding dog is slid out of the way and the spring lever and coil spring placed in position, the lever being forced into place by pressing down the bar handle. The application of the lid to the journal box is much facilitated if a block of wood 1 in. square and about 2 in. long is placed under the spring lever so that the lid can be hinged to the journal box easily. The block can then be knocked out, allowing the spring lever to bear against the box. Fig. 3 shows the reversed position of the tool to raise the spring lever for the purpose of inserting the block of wood.

This device can be mounted on a short piece of board instead of a box, if it is desired to carry it around the yard. However, if used around the shop, it is in a more convenient position if fastened to the top of a box.



Method of using a special tool recently made for removing and re-applying journal-box lid spring levers and coil springs
Fig. 1 **Fig. 2** **Fig. 3**

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Cast-Iron Wheels in Place Of Wrought Steel—Stenciling Questioned

The Huntingdon & Broad Top Mountain substituted a pair of cast-iron wheels in place of multiple-wear wrought-steel wheels under a Western Maryland car account of cut journal covered by a Pennsylvania defect

card. Charge was made for second-hand cast-iron wheels applied and credit allowed for multiple-wear wrought-steel wheels removed. The Western Maryland requested defect card, claiming wrong repairs, and rendered bill against H. & B. T. M. for expense of replacing multiple-wear wrought-steel wheels under the car. The H. & B. T. M. refused request for defect card and refused to approve bill for payment, claiming wrong repairs had not been made. Failing to agree the matter was mutually referred to the Arbitration Committee. The H. & B. T. M. stated that when car was on shop track, a close inspection was made and no stenciling for wrought-steel wheels as required in Section a, paragraph 1, of Rule 70 was found. Notation "Car not stencilled for wrot-steel wheels" was placed on billing repair card attached to bill. To request for defect card from the W. M. was attached a joint-evidence card to show wrong repairs. The Western Maryland submitted evidence showing that when car was built new in 1928 it was equipped with four pairs of wrought-steel wheels and was so stenciled, stenciling being placed on side-sill extensions at each end of the car. When car was switched to have wrong wheels removed inspection showed that stenciling for wheels was dim but still legible.

In a decision rendered April 7, 1933, the Arbitration Committee said: "Car owner makes positive statement that car bore stenciling 'Wrought-steel wheels' at time cast-iron wheels were removed and supports its statement with joint evidence. The contention of the Western Maryland is sustained."—*Case No. 1726, Huntingdon & Broad Top Mountain Railroad & Coal Company vs. Western Maryland.*

Responsibility for Car Damaged, Roof Boards Broken to Some Extent

The Oregon Short Line delivered a Pacific Fruit Express refrigerator car to owner's shop at Nampa, Idaho, and, on inspection, the roofing was found damaged to the extent of 62 pieces top course and five pieces bottom course boards requiring renewal, which damage was repaired. Request to Oregon Short Line for defect card covering damage was refused with claim that damage was not cardable under Rule 4. The Pacific Fruit Express stated that the roof boards had been side-swiped and that ends were split and feather edged. They also stated that the Oregon Short Line in refusing defect card had at first contended that roof boards were not broken to any extent and that no repairs were justified, but at a later date did not question the necessity of repairs but had held that they should be relieved of responsibility for damage in question. They contended that damage was cardable under Rule 4, Section e, inasmuch as failure to make repairs would have resulted in a leaky roof with possible damage to perishable commodities loaded in the car as well as to insulation. The Oregon Short Line said that car was jointly inspected before general car foreman and by the car foreman of the P. F. E. A lot of correspondence between the two companies was submitted. It was acknowledged by the O. S. L. that the roof boards were split or broken to some extent and had been slightly raked which resulted in ends being feather edged, but claimed that damage was not sufficient to come within the extent of making it a cardable defect under Rule 4, Section e.

In a decision rendered October 26, 1933, the Arbitration Committee said that "The evidence submitted in this case indicates that the roof boards in question were damaged sufficiently to make them cardable, under Rule 4, Section e. Therefore, the contention of the Pacific Fruit Express Company is sustained."—*Case No. 1728, Pacific Fruit Express Company vs. Oregon Short Line.*

Interchange of Loaded Car with Wheel Defects Requiring Renewal

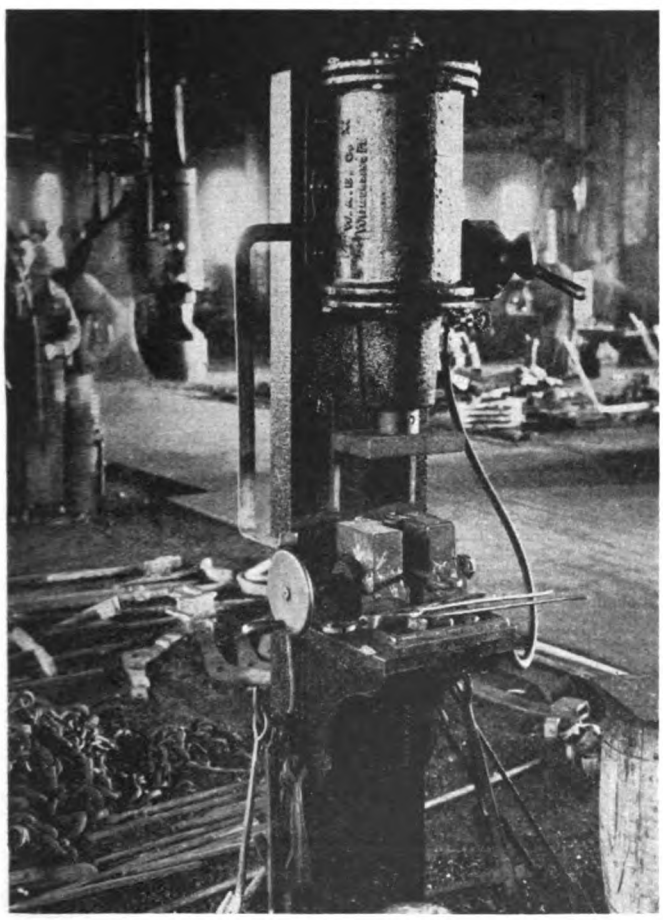
The Chicago, Indianapolis & Louisville delivered in interchange a Cleveland, Cincinnati, Chicago & St. Louis car loaded with coal to the Chicago, South Shore & South Bend. Inspection made by the C. S. S. & S. B. inspector before switching the car revealed that one wheel had a broken rim about 10 in. long and 4 in. of flange cracked. The C. S. S. & S. B. refused to accept the car. The C. I. & L. having offered the car in interchange refused to make repairs. The C. S. S. & S. B. stated that wheel had broken rim and cracked flange as set forth in agreed statement of facts and that the mate wheel was worn through chill which rendered car unsafe to handle as per A. R. A. Rule 2 which states: "Paragraph a, Cars (whether loaded or empty) having defects in violation of Safety Appliance Acts should not be offered in interchange." Reference was also made to interpretation of Arbitration Committee as follows: "Inter. (1) Q. Can a car be refused account welded truck side which may have been welded previous to January 1, 1920? A. Rule 2 gives the receiving line the right to refuse any car which in its judgment is unsafe for movement over its line. It is assumed that this question concerns a truck side with a defective weld." This interpretation, it is believed, indicates clearly that the committee considered it the right of receiving line to reject any car which in its judgment is unsafe for movement over its line. The Monon refused to make repairs unless the C. S. S. & S. B. authorized the expense of engine and crew to change the wheels, claiming that under Rule 2 such repairs were receiving-line responsibility and the car could not be rejected without first transferring the lading. Such expense would be an unnecessary expense to the C. S. S. & S. B. since repairs could be made under load. Paragraph (F), Item (9) of Rule 2 states: "(F) Transfer authority will not be issued account following defects: (9) Any other defects which can be repaired under load, or, if the car is safe to run and safe for lading, the receiving line to be the judge." Repairs were finally made by the C. S. S. & S. B., it being their contention, however, that A. R. A. Rule 2 gives the receiving line the right to reject this car on account of unsafe condition and that expense in excess of amount collectible from car owner, plus per diem, should be borne by the C. I. & L. Transfer of lading was not necessary, car being repaired under load. Failing to agree, the matter was referred to the Arbitration Committee. The C. I. & L. agreed to the facts, but contended that, in accordance with Rule 2, car should have been accepted by the C. S. S. & S. B. and either repaired or transferred.

In a decision rendered April 7, 1933, the Arbitration Committee said that: "Rule 2 reads in part as follows: 'Loaded cars offered in interchange must be accepted, with the following exceptions (a) to (e), inclusive.' These exceptions do not authorize the rejection of a loaded car for wheel defects. The contention of the Chicago, South Shore & South Bend is not sustained."—*Case No. 1727, Chicago, South Shore & South Bend vs. Chicago, Indianapolis & Louisville.*

In the Back Shop and Enginehouse

Pipe Clamp Forming Machine

AN efficient shop-made machine for forming all sizes and shapes of pipe clamps commonly used in locomotive repair work has recently been developed, as shown in the illustration, at the Milwaukee shops of the Chicago, Milwaukee, St. Paul & Pacific. It consists of an 8-in. air-brake cylinder mounted on a 12-in. channel which is set vertically in the blacksmith shop floor. The air cylinder is bolted to the upper end of



Pipe-clamp forming machine developed at the Milwaukee shops

the channel and provided with a flat die block keyed to the lower end of the piston sleeve.

An adjustable clamping die, made of a pair of jaws from an old 1½-in. bolt-threading chuck, is welded to the channel at a convenient height and forms the bottom dies used in making pipe clamps. These dies are adjustable horizontally for width by means of the hand wheel shown. Mandrels of the required shape and equipped with convenient handles are provided for use between the lower dies and the upper flat die secured to the piston sleeve. An outboard support for the stock which is being formed is provided, as shown at the left of the channel, and consists simply of a formed piece of ¼-in. by 1½-in. iron secured to one of the cylinder holding bolts.

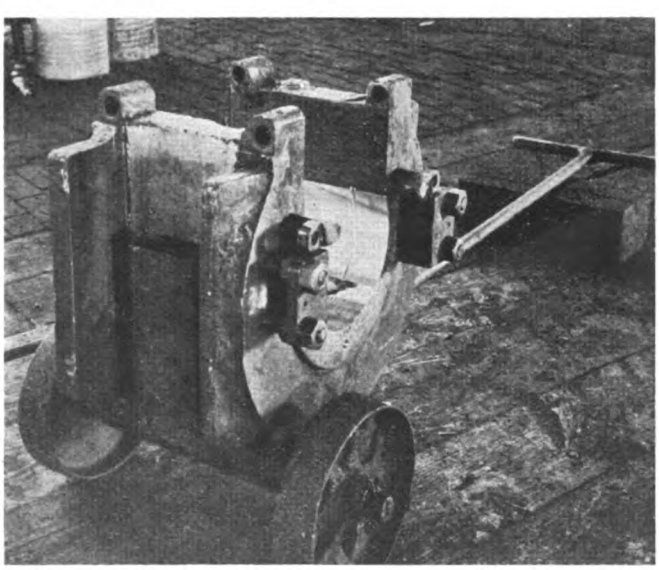
In operation, the stock is cut to the right length for each size clamp and formed hot in one operation. All sizes of pipe clamps, from ¼-in. to 2½-in., are made with one adjustable die, which avoids the necessity of having a bottom die for each size pipe clamp, and saves set-up time.

The clamps are usually made in lots of 200 to 300, uniformly accurate shapes being secured at a minimum expenditure of time and labor. The various kinds and sizes of mandrels used are shown attached to a hook on the left side of the machine, also leaning against the machine base at the right.

In addition to forming pipe clamps, this machine is used for numerous other small forming operations, the necessary small dies being simply gripped in the adjustable chuck jaws.

Driving-Box Handling Truck

A CONVENIENT two-wheel truck for handling driving boxes at the Clinton (Iowa) shops of the Chicago & North Western is shown in the illustration. This device consists of a pair of 12-in. truck wheels, mounted on an axle to the center of which has been welded a substantial L-shaped steel bar and a handle. This holding bar, which supports the driving box and fits in one of the shoe-and-wedge ways, is made of 1¼-in. by 5-in. stock cut from an old arch bar, the vertical leg of the L being approximately 12 in. long and the horizontal leg 24 in. long. A round handle,



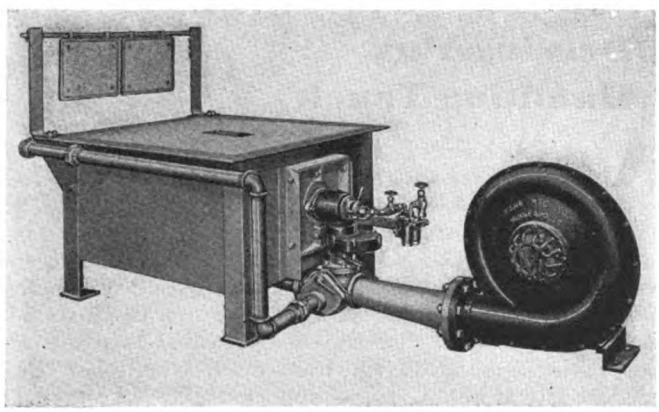
Safe and convenient two-wheel truck for handling driving boxes

welded to the horizontal leg, is provided with a cross bar at the outer end for convenience in handling.

The relatively large size truck wheels, with 2¾-in. face, facilitate easy movement about the shop, and the two-wheel truck arrangement without overhang enables the driving box to be moved through narrow places and readily turned in a space which would be too small for the passage of a four-wheel truck. Another important factor is the safety feature, in that the driving box, once loaded on this truck, can hardly be dislodged until purposely unloaded by tipping up the truck handle. Owing to the long leverage provided, one man can readily handle the largest driving box on this type of two-wheel truck.

Oil and Gas-Fired Blacksmith Forges

THE Mahr Manufacturing Company, Minneapolis, Minn., has developed an improved type of oil-fired blacksmith forge having air-curtain pipes and adjustable radiation shields, patented auxiliary air tunnel, twin oil strainer, and safety automatic shut-off oil valve. The use of this forge is designed to make it possible to realize on the following advantages of oil or gas fuel instead of coal or coke for heating in open-top blacksmith



Improved type of oil-fired blacksmith forge developed by the Mahr Manufacturing Company, Minneapolis, Minn.

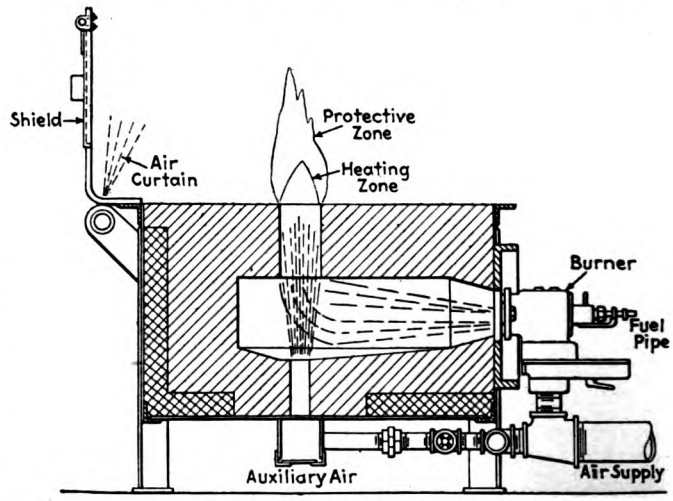
forges: Clean working conditions, reduced labor, quick heating, efficient use of fuel, and easy temperature regulation.

In connection with the latter advantage, coal and coke must be heaped on the fire at intermittent intervals. Fresh fuel cools the fire at first, then heating it to a maximum temperature and finally cooling it off as the fire burns out. Oil and gas on the other hand flow constantly at a uniform rate whether it is desired to have a high heat or a low heat. When coal and coke fuel beds burn thin, they allow more air to come through and scale the steel. The flame around the steel in an oil or gas forge stays the way the operator sets it with the valves.

The application of burners to blacksmith forges at first was accomplished by bricking up a right angle duct with the burner firing in a horizontal plane, the flame impinging the corner of the angle and deflecting upward to come out of the opening at the top of the forge. This method of firing was successful in some cases, and not so successful in others.

The cone-shaped flame of the Bunsen gas burner is generally familiar, as is the fact that the temperature and combustion conditions vary at different heights in the flame. Likewise, adjustment of the air inlet will raise or lower the tip of the inner and outer cones, illustrated.

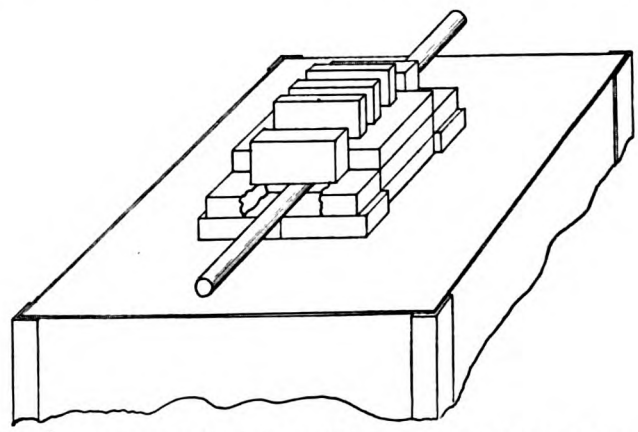
An improved and patented feature of Mahr blacksmith forges, both oil and gas fired, utilizes this principle of cone adjustment in flames. It consists of an auxiliary air tunnel with outlet at the bottom of the forge and upward into the center of the vertical duct, as shown in one of the illustrations. The correct length of



Cross-section showing the construction of the Mahr oil-fired blacksmith forge

the vertical and horizontal ducts for different fuels and the adjustment of the auxiliary air in combination with the burner regulates the height of the cone and the point of maximum temperature as required for forging and welding operations on different size sections.

The auxiliary air cushions the impact of the flame against the back wall of the forge and deflects it upward before it can impinge and concentrate the heat where it would melt the lining. It prevents the formation and accumulation of large slag puddles in the bottom of the forge. It accelerates combustion by the addition of air at right angles into a flame in the primary stages of burning.



View showing typical loose brick arrangement on top of forge

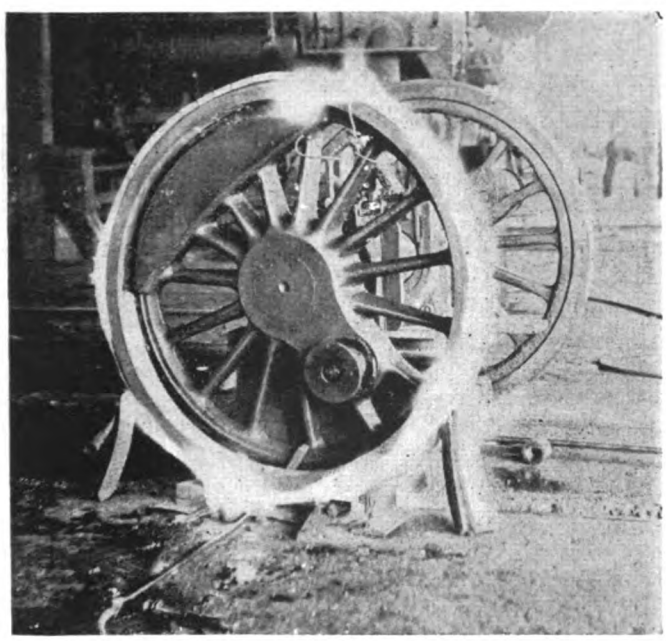
The forges may be furnished round or rectangular. The rectangular forge is easier to line with standard shaped firebrick. The round forge is the shape most familiar to old-timers in the ancient art of smithing and sometimes favored by them for that reason alone. Re-

gardless of shape, it is desirable to arrange loose brick around the piece being heated to concentrate the heat where it is most desired. This can be done on one or all sides and restricted or extended to various lengths, as illustrated.

The use of individual blowers is suggested for air supply regardless of the kind of fuel used, as a constant, steady air pressure is maintained, long leaky air lines are eliminated, single forges may be operated economically, and the initial investment is low.

Damaging Wheel Centers By Excessive Heating

THE number of cracked spokes and in some cases, wheel centers that were found on one railroad were traced to excessive heating of the wheel during the application of tires. An investigation disclosed that little thought was being given to this feature by the employes performing this work and frequently, while the tire was being heated, in much the same manner as is shown in the illustration, those assigned to perform this work engaged in some other job until they thought the tire



To avoid heating the wheel centers, one road uses dummy centers while heating tires

had been heated sufficiently to permit of its application to the wheel center.

As a consequence of this lack of attention the wheel center was usually excessively heated and during the shrinkage operation damage was being done to the spokes and other parts of the wheel.

If the expanding of tires is closely watched by competent mechanics and care is exercised to see that only the tire itself is heated there is no danger of damaging the wheel center; however the railroad in question has discontinued the practice of applying the tire to the wheel during the expanding process and has installed "dummy" wheel centers of suitable sizes at the various roundhouses and shops on which the tires alone are heated. They are then transferred to the wheel centers to which they are to be applied.

Making Spring Hangers Without Drilling

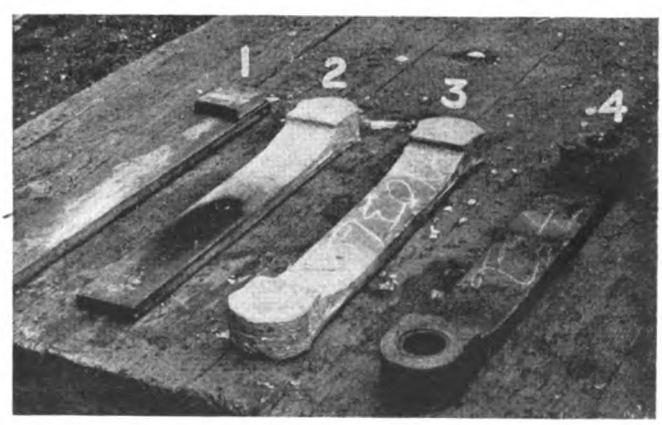
A NEW method of making spring hangers, which is now being tried at the Milwaukee shops of the Chicago, Milwaukee, St. Paul & Pacific, is of special interest because hangers of standard size and good quality are secured without the necessity of any drilling operation for the application of the bushings. The



Spring hangers loaded on two lift-truck skids ready for punching the ends and insertion of hardened steel bushings

hangers are made of low-carbon steel so as not to harden appreciably when suddenly immersed in cold water, as required following one of the operations. The stock consists of 7/8-in. by 3½-in. material, to which is added a lap 3⅛ in. long on each end. In general, the method consists of forming the enlarged ends on the spring hangers in a forging machine, punching holes of the required size in the ends, and, while the metal is still hot, inserting casehardened bushings, the spring hangers then being cooled quickly in a water bath before the heat has had time to affect the casehardened bushings.

Referring to the illustration, the various operations in making spring hangers by this method are illustrated. The stock, sheared to the proper length and provided with a lap on one end, is shown at *1* in the first illustration. This blank is heated in an oil-fired furnace and upset in two operations on a 4-in. Ajax forging machine



Four steps in the manufacture of a spring hanger in which bushings are applied without drilling the hanger

to the shape shown at 2. In the first of these operations, the lap is welded to the main stock and the largest portion of the stock necessary to form the end of the hanger is accumulated. The second operation completes the upset on one end. It is necessary to make the hanger a little greater in width than the finished hanger in order

to provide for subsequent operations. The other end of the hanger is then forged, as shown at *3*. The concluding operation consists of reheating the hangers, one end at a time, and punching 2-$\frac{5}{16}$-in. holes, in which casehardened bushings are inserted, as mentioned, and the spring hangers cooled quickly in a water bath. The completed hanger is shown at *4* in the illustration, having been made without any drilling or machine-tool operations, except in the manufacture of casehardened bushings.

All spring hangers made by this method are tested on a special gage block to assure their being of the proper length, with holes parallel. This gage consists simply of a heavy cast-iron block in which positioning holes have been drilled with centers spaced to all standard spring-hanger lengths. Plugs of the proper size are provided for insertion in these holes, the enlarged upper ends of these plugs being a close fit in the casehardened bushings. Spring hangers are not accepted for use at Milwaukee shops or for shipment to other parts of the system unless they fit over these gage plugs and a high degree of accuracy is, therefore, assured.

Tool Drawers And Vise

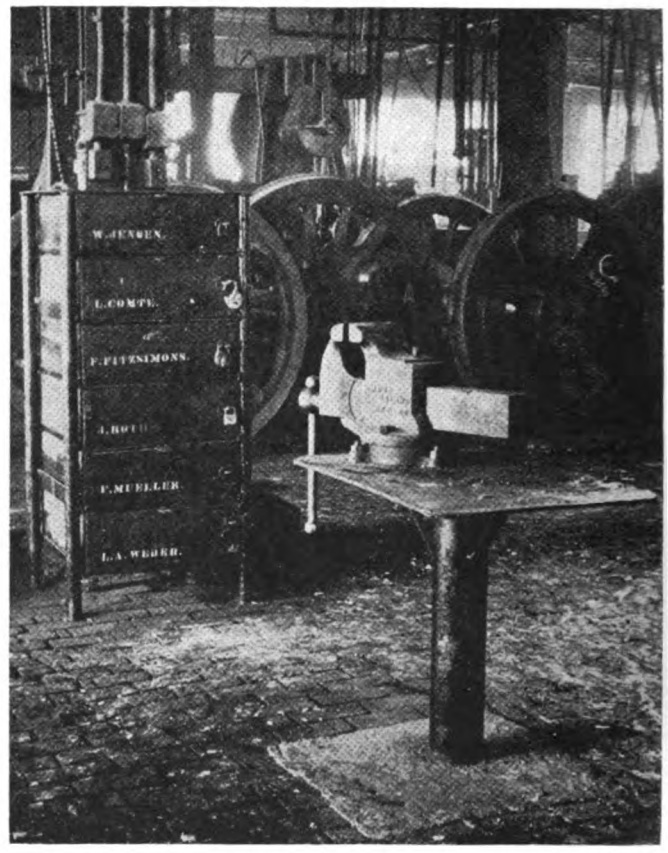
PARTICULAR emphasis is placed on order and cleanliness at the Clinton (Iowa) shops of the Chicago & North Western, and one factor which contributes much to this desirable condition is the use of vertically-stacked tool drawers for individual workmen; also numerous conveniently-located vise stands of the type shown in the illustration.

In many shops, machinists employed in the erecting department are assigned individual drawers in the conventional type of horizontal work bench, which, in addition to taking up a large amount of floor space, are frequently located against the walls or between the pits where they provide numerous dark corners and spaces in which much scrap and other material, as well as dirt, accumulate. This type of work bench has been completely discarded in the Clinton erecting shops in favor of the neat and convenient vertically-stacked drawers, illustrated.

The stand for holding the standard tool drawers, formerly used in the horizontal-type bench, is built largely of scrap material and consists of four vertical corner posts, 56 in. high, made of old boiler tubes which are spaced by, and firmly welded to, seven $\frac{1}{8}$-in. steel horizontal sheets which support the tool drawers and form a cover for the top drawer. The dividing sheets are flanged upward $\frac{3}{4}$ in. on two sides to facilitate sliding of the drawers. The names of individual workmen are stenciled on the drawers, which are locked by means of padlocks and hasps welded to the corner posts.

It will be noted that the lowest drawer is placed about 6 in. above the floor to facilitate cleaning underneath. In addition to promoting a clean condition of the floor, with attendant increased safety and ease of working, the vertical tool drawer arrangement, illustrated, gives more room between pits and more light.

The vise stand, conveniently located, as shown in the illustration, also is designed to take up a minimum of shop space and facilitate maintaining a clean floor condition. This No. 98 Rockford vise, with 7-in. jaws, is bolted to a $\frac{3}{8}$-in. steel plate, 30 in. long by 24 in. wide and located 28 in. high above the floor. The plate is welded onto the upper end of a section of a scrap superheater flue, set in a substantial concrete foundation in the floor. For suitable rigidity, this foundation block is made about 3 ft. deep. The vise-supporting plate, in addition to being welded onto the top of the superheater flue, is provided with two braces, welded in place as illustrated, to give additional stiffness and rigidity. In actual practice this vise stand construction has been found to have adequate strength, take a minimum space and facilitate maintaining a clean floor condition.



Convenient vertically-stacked tool drawers and rigidly-supported vise stand

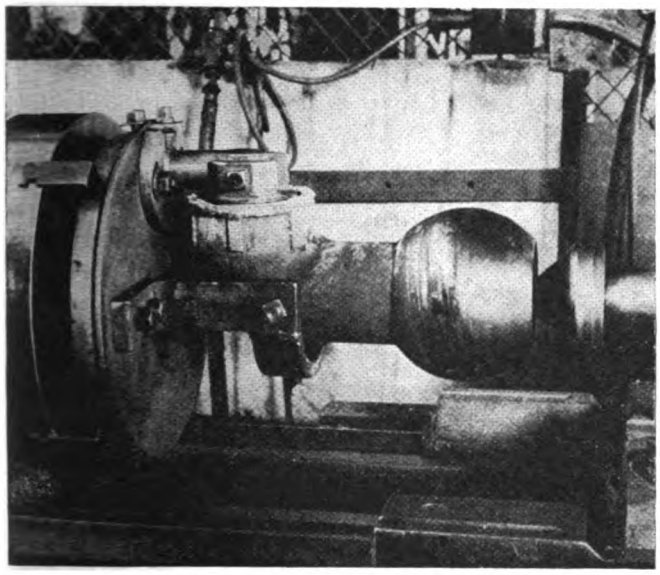
Machining Booster Steam-Pipe Balls

AN interesting method of reconditioning worn booster steam- and exhaust-pipe balls has been developed, as shown in the illustration, at the Clinton (Iowa) shops of the Chicago & North Western. These ball joints are subject to wear and cutting by the packing and gland and, as a result, steam leaks develop.

To avoid the expense of scrapping these worn ball joints, the general method of procedure followed at the shops referred to is to undercut the worn ball $\frac{1}{8}$ in. on the diameter and build up $\frac{1}{4}$ in. larger than the finished size—using a special bronze-welding material—then finishing the ball to the proper diameter, the same as when new. By this method a smooth and accurately-finished ball is obtained and the application of a special lubricating ring is expected to prevent further difficulties from this source.

To facilitate proper handling of the machine operations required in this reclamation job, an interesting

holding jig has been developed at the shops. The holding jig, shown in the illustration, consists of a low-pressure air-pump piston head, held in the chuck jaws and provided with a yoke made of ¾-in. by 2-in. stock, shaped as shown and bolted to the head. Three ⅝-in. set screws are provided to position the elbow, which is threaded onto a swivel block hinged to a post, adjustably bolted to the upper part of the piston head. This swivel block is capable of adjustment vertically by means of slotted holes, through which the two holding bolts



Special jig for holding booster steam- or exhaust-pipe ball joints while being machined

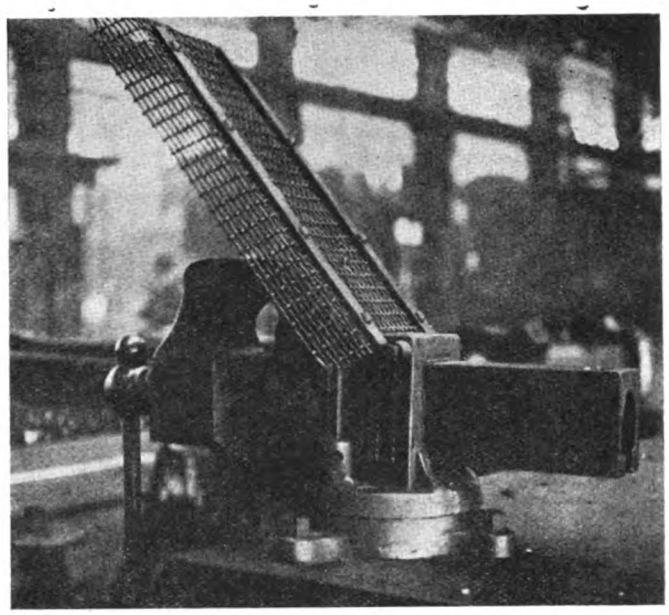
pass, and suitable adjusting screws. The ball end of the elbow is centered by means of a special ball-bearing center in the tail stock of the lathe.

A little study of the illustration will show that this holding fixture permits easy and accurate adjustment and centering of this awkward-shaped part. In addition, once this elbow is properly centered and the set screws tightened, it is firmly held in the correct position and is not likely to slip during the machining operation. Any preferred type of radius-turning attachment can then be applied to the lathe carriage and used for machining the ball shape.

Adjustable Bench-Vise Shield

SOME time ago the *Railway Mechanical Engineer* published an article describing a "screen shield for the bench vise." It consisted of a piece of front-end mesh attached to the back or side of the bench which prevented chips from flying when chipping was done at the vise. The shield shown in the illustration is attached to the vise, being secured by two ¾-in. studs tapped into the body of the vise as shown. When chipping is being performed or rivet or bolt heads are being removed from material placed in the vise the shield can be turned up in position as shown. When it is not required for use as a shield the screen can be lowered and will not interfere with any other type of material that it is desirable to place in the vise.

The shield is made from ordinary front-end mesh of

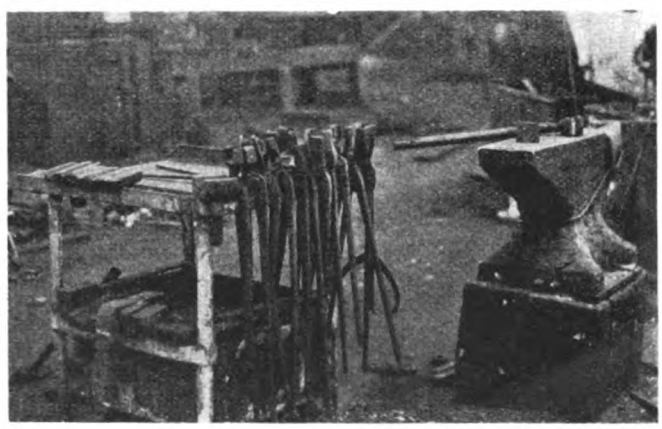


A removable bench-vise shield

the size desired and is riveted to two ½-in. by 1-in. strap-iron hinges.

Blacksmith Shop Tool Rack

TO afford a more convenient and systematic arrangement of tools at each blacksmith's forge the general foreman at one back-shop installed the type of rack shown in the photograph. The rack is made from ½-in. by 2-in. bar iron which is welded together. Provision is made on one side to insert the various types of tongs that are needed and on the other side for anvil inserts. A cooling tank is also provided under the rack.



A tool-rack, a table and a cooling tank, in one

A steel plate applied to the top provides a safe place for laying out blue-prints which the blacksmith is required to consult or can be used as a work bench instead of the usual table—the anvil.

NEW USE FOR OLD "HACKS."—The University of North Dakota has found a novel way to help students of more ambition than wealth. Half a dozen old railway cabooses have been turned into a dormitory unit and some 30 students are comfortably housed in them.

Among the Clubs and Associations

TORONTO RAILWAY CLUB.—W. H. Winterrowd, vice-president of the Lima Locomotive Works, discussed the Relation of the Locomotive to the Operating Income Account at the May 4 meeting of the Toronto Railway Club.

NORTHWEST CAR MEN'S ASSOCIATION.—O. E. Ward, superintendent of motive power of the Chicago, Burlington & Quincy, discussed Light Weight Railroad Equipment at the meeting of the Northwest Car Men's Association held on May 7 at St. Paul, Minn.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—The speaker at the May 10 meeting of the Car Foremen's Association of Omaha at Council Bluffs, Iowa, was K. H. Carpenter, general car foreman of the Missouri Pacific, who presented a paper on Maintenance of Passenger Equipment.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—At the meeting of the Car Foremen's Association of Chicago, to be held at 8 p. m. on May 14 at the LaSalle Hotel, Chicago, W. E. Dunham, superintendent of the car department of the Chicago & North Western, will discuss Accident Prevention in the Car Department.

CANADIAN RAILWAY CLUB.—"English vs. Canadian Standards of Construction of Locomotive and Car Equipment and Methods of Operation" is the title of a paper to be presented by W. Walker, acting superintendent of motive power and equipment of the Canadian National Railways, at the meeting of the Canadian Railway Club which will be held at 8 p. m. on May 14 at the Windsor Hotel, Montreal. This paper was the winner in the regular annual competition sponsored by the Canadian Railway Club among junior railway employees in Canada.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The tentative program arranged for the semi-annual meeting of the A.S.M.E, which will be held at the Cosmopolitan Hotel, Denver, Colo., June 25 to 28, includes, among other subjects, papers on passenger tramways; smoke problems; heat engineering—covering air conditioning, experiences in burning pulverized lignite, and petroleum coke; and recent progress of high-speed light-weight railroad trains, with discussions by representatives of the Chicago, Burlington & Quincy and the Union Pacific—the new three-car articulated train units of which roads may be available for inspection during the meeting.

PURCHASES AND STORES DIVISION.—In accordance with a recommendation of the Federal Co-ordinator, the Purchases and Stores Division, American Railway Association, has appointed a special committee, to study purchasing methods. This committee, which consists of F. D. Reed, purchasing agent, Chicago, Rock Island & Pacific; A. C. Mann, vice-president and purchasing agent, Illinois Central; and C. E. Walsh, purchasing agent, Pennsylvania, is considering a plan to form regional boards of railway purchasing officers to review copies of all orders placed by railways for supplies and to study these orders to determine the extent of adherence to A. R. A. standards and specifications, the routing of railway material and the prices paid for material. The committee has recommended giving the plan a trial in one region by the formation of a committee of purchasing officers of not more than six railroads with offices in the city of Chicago, and authorizing this committee to act as the reviewing board during the trial period. ¶ The General Committee and Advisory Committee of the Division have decided that no annual meeting of the Division shall be held this year. Instead, a meeting of the General and Advisory committees will be held in Chicago June 8, at which the chairmen and members of subject committees will present completed recommendations, and at which the winners of the annual essay contest will present their papers. ¶ D. C. Curtis has been appointed chairman of a committee to study the proposed code of the bolt, nut and rivet industry.

Directory

The following list gives names of Secretaries, dates of next regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 2205, 150 Broadway, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—Division V.—MECHANICAL.—V. R. Hawthorn, 59 East Van Buren street, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorn, Chicago.

DIVISION VI.—PURCHASE AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Columet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, Room 332, 30 Church street, New York. Spring meeting, Denver, Colo., June 25-28.

MACHINE SHOP PRACTICE DIVISION.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—Edgar J. Kates, 1350 Broadway, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, La Salle Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth street, Council Bluffs, Iowa. Regular meetings, second Tuesday of each month at Council Bluffs.

CENTRAL RAILWAY CLUB OF BUFFALO.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month except June, July and August, at Hotel Statler, Buffalo.

CLEVELAND RAILWAY CLUB.—F. B. Frericks, 14416 Alder avenue, Cleveland, Ohio. Meetings temporarily suspended.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon, 12:15 p. m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha street, Winona, Minn.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN.—C. L. Roberts, R. F. D. 5, Peoria, Ill.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md. Annual meeting October 17-18, Hotel Stevens, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TORONTO RAILWAY CLUB.—N. A. Walford, district supervisor car service, Canadian National, Toronto, Ont. Meetings first Friday of each month except June, July and August.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—C. L. Emerson, 822 Straus Building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

NEWS

Machine Tool Survey Made for the Federal Co-ordinator

IN AN effort to determine to what extent modern machine tools might contribute to economies in locomotive and car maintenance a survey has recently been completed in a large railroad shop for the Federal Co-ordinator of Transportation by a group of machine-tool engineers, selected from member companies of the National Machine Tool Builders' Association. This survey, which was primarily a fact-finding study to produce basic data as to the savings which can be made by the replacement of obsolete machine tools with modern machines, is one of several projects under way by which it is expected that definite recommendations may eventually be made which will promote economies in railroad operation and maintenance. In making the machine-tool study in question no attempt was made to take into consideration the entire problem of locomotive and car repairs, but the investigation was confined solely to machine-tool operations.

Arch-Bar Trucks

INTERCHANGE RULE 3, section t, paragraph 3, provides that, effective January 1, 1936, cars with arch-bar trucks will not be accepted from car owners. For a number of years the Mechanical Division of the A. R. A. has sent out an annual questionnaire to all railroads and owners of private-car-line equipment and from the responses has tabulated the condition of freight cars as regards type of truck—arch-bar or cast-steel side frame. A statement showing the kinds of trucks on interchange freight equipment as of January 1, 1934, has just been issued. This includes for railroad owned equipment, 219 replies, 2,251,071 interchange freight cars owned or controlled, of which 780,762 cars, or 34.7 per cent, were equipped with arch-bar trucks. From private car lines 196 replies were received. These showed 294,546 cars owned or controlled, of which 121,595, or 41.3 per cent, were equipped with arch-bar trucks. Combining railroad and private car-line equipment, the statement shows 2,545,625 cars owned or controlled, of which 902,357, or 35.4 per cent, were equipped with arch-bar trucks.

During the past four years there has been a slow, but steady, decrease in the number of arch-bar trucks. The tabulation for January 1, 1930, showed 43.6 per cent of railway owned interchange freight equipment, 49.5 per cent of private-car-line equipment, and 44.2 per cent of all interchange equipment had arch-bar trucks.

Progress in Air-Conditioning Programs

Road	No. of cars	Type of car	Type of System	Builder
Boston & Maine and Maine Central	4	Diners	Ice	Rails Co.
	4	Comb.de luxe smok. cars	Ice	B. F. Sturtevant Co.
	9	de luxe coaches		
Erie	18	Pull. sleepers	Steam eject.	Safety Car Htg. & Litg. Co.
	14	Coaches		
	2	Parlor-buffet		
	2	Diners		
New York Central	6	Diners	Electro.-Mech.	Frigidaire-Westinghouse
	9	Coaches		
New York, New Haven & Hartford	50*	de luxe light-weight streamlined coaches	.....	Gen. Elec.-Sturtevant
Pennsylvania	38†	Pass.	Ice	.....
	18†	Comp.		
	23†	Comb. pass.-bagg.		
	30†	Diners	Mech.	Frigidaire
	299	Pull. sleepers	Ice	.....
	26	Pull. parlor		

* These are new cars, the order for which has been placed with the Pullman-Bradley Car Corp. as noted in the P. W. A. item in the April issue. These cars, while radically different in design, will be operated, as far as possible as unit trains, but will be interchangeable with present equipment if occasion demands. The new coaches will be of aluminum and light weight materials, the weight per car being approximately 100,000 lb.
† Work being done at Altoona shops.

Identification Marking for Automobile Cars with Loading Racks

THERE ARE several thousand automobile box cars in service equipped with mechanical loading devices. In harmony with the expressed opinion of the Car Service Division that the movement of such cars would be facilitated if they were provided with identification marking and upon recommendation of the Committee on Car Construction the Mechanical Division of the American Railway Association has taken a letter ballot on the addition of the following note for Fig. 1, page 40, Section L, of the Manual:

"Note 13. For automobile box cars equipped with automobile loading racks a 3-in. white stripe is to be painted on the right-hand door, facing side of cars, extending full width of door, approximately 3 ft. above floor line, and immediately above this stripe the words "Auto Rack" are to be stenciled in white letters 2 in. high; this marking to be applied to both sides of car."

The proposition was approved and has been made effective immediately.

Basic Wage Rates To Be Restored Gradually

A COMPROMISE settlement of the railway wage controversy on the basis of a gradual restoration of the 10 per cent deduction now in effect was announced on April 26 by the Conference Committee of Managers and the Railway Labor Executives' Association after the labor organizations had previously declined to accept President Roosevelt's proposal that the present agreement be extended six months, and after Co-ordinator Eastman had withdrawn as Mediator. The agreement, proposed by the railroad committee and ratified by the general chairman of the labor organizations provides for restoration of one-quarter of

New Equipment

CAR ORDERS

Road	No. of cars	Type	Builder
Alaska R. R.	10	Air-dump	Western Wheeled Scraper Co.
C. M. St. P & P. (see note)	2	Air-dump	Western Wheeled Scraper Co.
Chilean State Rys.	15	Coaches	Bethlehem Steel Corp.
D. L. & W.	350*	50-ton steel hopper	American Car & Fdry. Co.
	150*	50-ton steel hopper	Magor Car Corp.
Erie	50	50-ton bulk cement	Greenville Steel Car Co.
G. M. & N.	100*	Box	
	50* **	Box-car parts	American Car & Fdry. Co.
	50* **	Gondola-car parts	
U. S. Navy	2	50-ton box	Haffner-Thrall Car Co.
	3	50-ton flat	Haffner-Thrall Car Co.

CAR INQUIRIES

Boston & Maine	21*	Suburban	.....
	3*	Diesel rail-motor cars	.....
C. of Ga.	200*	70-ton hopper	.....
C. G. W.	500*	50-ton box	.....
P. S. & N.	150	50-ton hopper	.....
S. A. L.	10	Box-car underframes	.....

LOCOMOTIVE ORDERS

Road	No. of locomotives	Type of locomotive	Builder
Chilean State Rys.	10	2—8—2	Baldwin Locomotive Works
D. L. & W.	20*	4—8—4	American Locomotive Co.
	2*	600-hp. oil-elec.	General Motors Corp. (Winton Engine Co.)
	2*	600-hp. oil-elec.	Ingersoll-Rand Co.
Lehigh Valley	5*†	4—8—4	Baldwin Locomotive Works
U. S. Navy	2	300-hp. Diesel	American Locomotive Co.

LOCOMOTIVE INQUIRIES

B. & M.	5*	4—6—2	.....
	5*	4—8—2 or 4—8—4	.....
	1*	Diesel-switch.	.....

* To be purchased with money loaned by the P. W. A.
** These cars are to be built in the shops of the G. M. & N.
† Two of these locomotives will be equipped throughout with Timken roller bearings on all axles, including driving axles. Timken roller bearings will be used on the engine trucks of all five locomotives.
Note: 50 coaches and 25 baggage-express cars, for which inquiry has been made, will be built in the shops of the C. M. St. P. & P. The money for this work has been loaned by the P. W. A.

the reduction July 1, one-half on January 1, 1935, and the remaining quarter on April 1, 1935.

The agreement stipulates that basic rates of pay until changed upon notice, as hereinafter provided, shall remain the same as under the agreement of January 31, 1932, as extended. The agreement also provides that no notices of changes in basic rates shall be served by any party upon any other party prior to May 1, 1935.

School of Air Conditioning

A SCHOOL of air conditioning has been organized at Kansas City, Mo., by employees of the Kansas City Pullman Company, Kansas City Terminal Company, Rock Island, Santa Fe, Kansas City Southern, Union Pacific, Missouri Pacific and Burlington. The total enrollment is 145 men, and classes, divided into four groups, are held each night in the week except Sunday. There are also classes on Monday, and on Thursday afternoons, for the benefit of the men who will have to service the air-conditioned cars that come into the station or yards at night. The course of study will include terms and definitions, study of the psychrometric chart, coefficient of heat transfer, sensible and latent heat, sun effect on steel cars, estimating cooling and heating requirements, cooling and heating coils, pumps and motors, air filters, blowers, ducts and outlets, ice bunker system, mechanical refrigeration system, steam-generating system and precooling of cars. The school was arranged for through the work of E. M. Eardley and E. O. Grimm, of the Pullman Company. The instructor is M. W. Pehl, air-conditioning engineer, formerly connected with National Air-Control Company, New York.

P. W. A. Loans to Railroads

CONTRACTS signed or allotments made since the publication of the April *Railway Mechanical Engineer* are as follows:

Baltimore & Ohio.—An additional allotment of $900,000 has been made to the B. & O. which will enable it to put two high-speed light-weight trains in operation, one of which will be the first streamline train to be operated by steam power, while the other will be operated by an 1,800-hp. Diesel-electric engine, and both of which will be capable of 90 to 100 m.p.h., although it is not anticipated that it will be necessary to operate that fast on regular schedules. The amount of the loan will be used to purchase the Diesel-electric engine and 16 passenger coaches. The steam locomotive is a 4-4-4 type Class J-1 locomotive, which will be converted by the B. & O. at its own shops.

Both locomotives and cars have been designed to offer the least resistance to the air at high speeds, although the design is considerably different from that of the high-speed trains recently put into service by the Union Pacific and the Chicago, Burlington & Quincy, and the cars will not be as radically different from the standard passenger cars. Each will be an independent unit with two four-wheeled trucks. The superstructure of the cars in one train will be of U. S. S. Cor-ten, a corrosion-resistant, high-tensile steel, while that of the other will be aluminum alloy, thus enabling the B. & O. to test the relative merits of both materials as well as to determine whether steam or Diesel-electric power is the better for the service in which these trains are to be used. Each train will consist of six cars and locomotive, four cars being held in reserve. Each will include a combination passenger-baggage car, two reclining seat cars, a combination lounge-dining car, a chair car and an observation chair car. The three coaches will seat 176 passengers, while the two chair cars will seat 32 passengers each.

Both cars and locomotives have been designed to lower the center of gravity by a reduction in the overall height of the cars and the reduction of the weight of the superstructure.

All cars will be completely air conditioned, permitting the windows to be set flush with the sides so that there wll be no recesses in the car sides to create air resistance. The usual roof ventilators also will be elminated, further reducing resistance. The rear end of each observation car will be tapered and rounded to reduce the rear end vacuum drag.

The steam locomotive will carry a jacket over the boiler to cover the air pumps, steam dome, piping and other projections that multiply air resistance on locomotives designed before air resistance was recognized as an important factor.

The total weight of the engine will be 213,800 lb., of which 99,800 will be on the four driving wheels. The drivers will be 7 ft. in diameter. Steam pressure will be 350 lb. per square inch, approximately 100 lb. higher than the pressure carried by most locomotives.

Delaware, Lackawanna & Western.—A contract has been signed for a loan of $3,623,000 to this road for the purchase of the cars and locomotives listed in the New Equipment table. A contract covering a loan of $1,043,000 to the Lackawanna to enable it to repair engines and cars that it already owns is in process of preparation.

Great Northern.—An allotment of $850,000, in addition to the $4,935,000 contract which has already been signed as noted in the April issue, has been made for the Great Northern. The new allotment will be used to apply steel underframes and make other improvements on 650 refrigerator cars in the Great Northern's shops at St. Cloud, Minn., where about 330,000 man-hours of additional employment will be provided for the company's shop forces.

Interstate.—A contract for a loan of $250,000 enables the Interstate to give its shop forces at Andover, Va., 130,000 man-hours of additional employment in rebuilding 500 coal cars.

Lehigh Valley.—The contract signed for the Lehigh Valley totals $600,000, which will be used for the purchase of the locomotives listed in the New Equipment table.

Midland Continental.—A contract for an allotment of $36,000 to the Midland Continental has been signed. This amount will be used in connection with the purchase of a new Diesel-electric locomotive. This locomotive will cost $52,000. The balance required above the $36,000 will be supplied by the railroad.

New York, New Haven & Hartford.—Contracts for loans of $1,300,000 for rail and $2,300,000 for equipment have been signed for this road.

Contracts for the purchasing and laying of new rail, fastenings, switches, etc., have been signed for the Maine Central ($313,000) and the New York Central ($2,500,000).

Inquiries and orders placed for equipment to be purchased with money loaned by the P.W.A. are shown in the New Equipment table elsewhere on these pages.

Supply Trade Notes

L. G. SEVER, assistant to the president of the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., has been appointed vice-president and manager of sales.

E. W. BACKUS, western representative of Standard Equipment, Inc., New York, with headquarters at Chicago, has been appointed chief engineer in addition to his present duties.

H. D. BINKS, who was president of the Binks Spray Equipment Company, Chicago, until 1929, has organized the H. D. B. Corporation, with general offices and plant at 900 North Spaulding avenue, Chicago, to manufacture spray guns and allied equipment.

JOHN L. RANDOLPH, formerly vice-president of the Franklin Railway Supply Company, Chicago, has organized John L. Randolph & Son, with offices at 1017 McCormick building, Chicago, to engage in the sale of railway supplies.

JOHN E. DIXON, vice-president in charge of sales of the Lima Locomotive Works, Incorporated, since its reorganization in 1916, has been appointed vice-president in charge of both sales and engineering. Mr. Dixon's headquarters will continue to be at New York.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, at its annual meeting on April 11, elected two new directors, A. L. Humphrey, chairman of the board of the Westinghouse Air Brake Company, and H. S. Wherrett, president of the Pittsburgh Plate Glass Company. At the same meeting five other directors now serving on the board were re-elected.

H. S. COLBY has been appointed general sales manager of the Combustion Engineering Company, New York. Mr. Colby, until recently, was president of the Air Preheater Corporation. For the past 20 years he has been engaged in the design, production and sales of steam generating equipment involving boilers, stokers, pulverizers, economizers and air preheaters.

THE DAVENPORT BESLER CORPORATION has become the successor to the Davenport Locomotive & Manufacturing Corporation. at Davenport, Iowa.

THE AIR REDUCTION SALES COMPANY, New York, will act as distributor of the new low melting point brazing alloy "Sil-Fos" made by Handy & Harman. This alloy is noticeable for its low melting and flows freely at 1,300 deg. F., or from 300 to 600 deg. lower than ordinary brazing alloys used for brass, bronze, copper, or other base metals.

E. A. TURNER, for the past six years patent solicitor of The Standard Stoker Company, Inc., has been appointed also assistant to the president with headquarters at New York. Prior to his association with The Standard Stoker Company, Mr. Turner was development and patent engineer of the Locomotive Stoker Company.

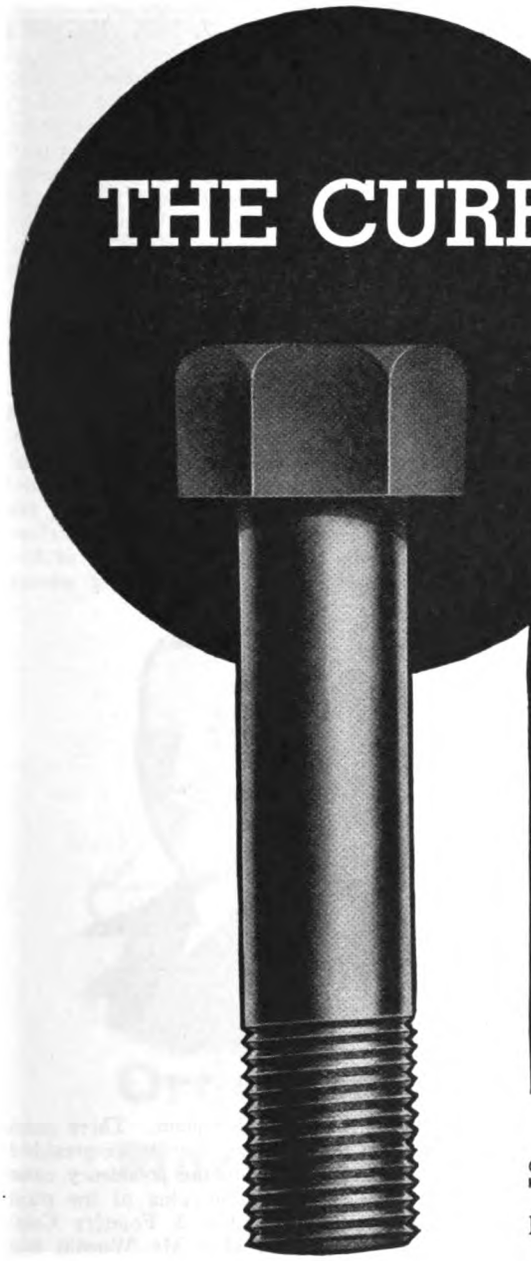
WILLIAM H. WHITE, until recently associated with the Graham-White Sander Corporation, Roanoke, Va., has been appointed southeastern representative of the T-Z Railway Equipment Company and the Morris B. Brewster Company, Chicago, with headquarters at Roanoke.

BATT L. SPAIN, who has been for the past 24 years with the General Electric Company at the West Lynn, Mass., works as manager of turbo-blower sales, is now connected with the Ingersoll-Rand Company as manager of the turbo-blower department. He will be located at the general offices, 11 Broadway, New York. The transfer of Mr. Spain follows the acquisition of the turbo-blower business of the General Electric Company by the Ingersoll-Rand Company.

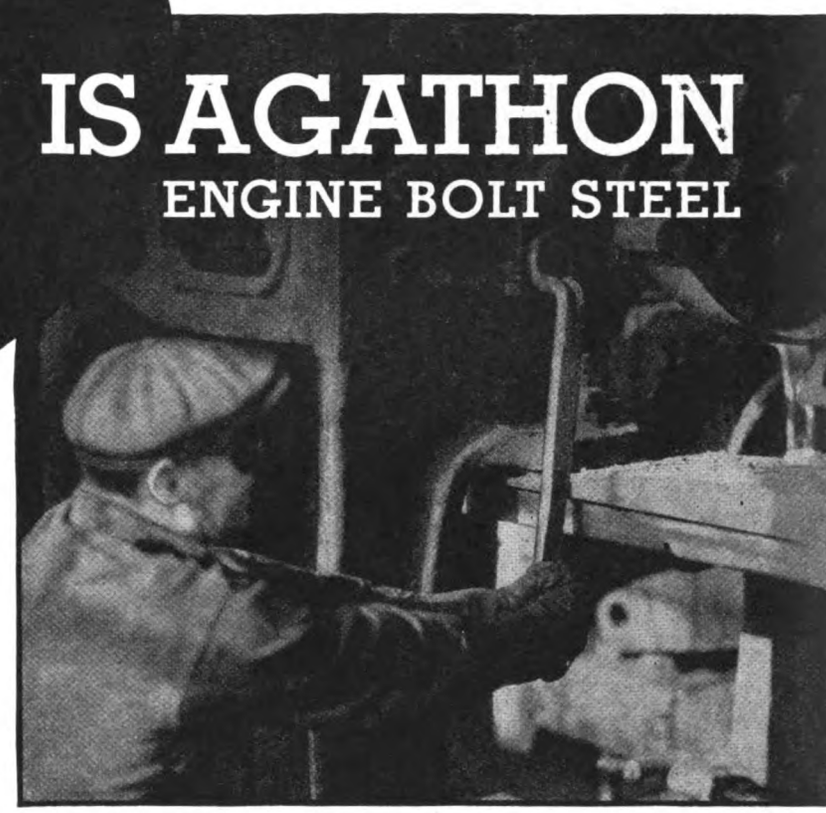
J. H. BENDIXEN, vice-president and manager of sales of the Bettendorf Company, Bettendorf, Iowa, has been elected chairman of the board and first vice-president and manager of sales, and E. J. Bettendorf, secretary and treasurer, has been elected president, to succeed J. W. Bettendorf, de-

(*Continued on next left-hand page*)

THE CURE FOR STRETCHING TRAIN BOLTS



IS AGATHON ENGINE BOLT STEEL



So powerful are the unbalanced forces tearing away at engine bolts, that one road was compelled to renew 50% of its frame bolts at each shopping. » » » The old material was not equal to the greater stresses caused by the speeding up of operation. » » » But, by using engine bolts of Agathon Alloy Steel, replacements were reduced to a negligible quantity. » » » Agathon Engine Bolt Steel possesses the fatigue resistance that in the past made iron the favored material, but it has the necessary high tensile strength to hold without stretching. » » » Agathon Engine Bolt Steel is uniform and free from the slag pockets, seams and inclusions. » » » It is the modern engine bolt material developed for modern railroading.

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AGATHON STEELS

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES YOUNGSTOWN, OHIO

ceased. Other officers elected are: W. E. Bettendorf, secretary; J. L. Miclot, assistant secretary; and A. J. Bettendorf, assistant treasurer.

R. B. MILDON, recently in charge of the stoker department of the Westinghouse Electric & Manufacturing Company, has been elected vice-president in charge of the operations of marketing, engineering, manufacturing and service in connection with the products of the South Philadelphia, Pa., works, where he will have his headquarters.

THE GATE CITY IRON WORKS, Omaha, Neb., has been appointed distributors of Enduro stainless steel and Toncan copper molybdenum iron; the Barde Steel Company and the Doran Company, both of Seattle, Wash., and Earle M. Jorgensen Company, Los Angeles, Cal., have been appointed distributors of Enduro stainless steel, according to a recent announcement of the Republic Steel Corporation, Youngstown, Ohio. Enduro is produced by the Central Alloy division of Republic, Massillon, Ohio.

Frank H. Cunningham has been appointed western sales manager of Graham-White Sander Corporation with headquarters at Chicago. Mr. Cunningham received his technical training at Virginia Polytechnic Institute and after an apprenticeship on the Norfolk & Western served as assistant engineer of tests and supervisor of locomotive stoker performance. He then went to the Standard Stoker Company as assistant general manager and later to the Franklin Railway Supply Company as district service manager.

THE RAILWAY CAR APPLIANCES ASSOCIATION, organized as a division of the Fabricated Metals Products Manufacturing and Metal Finishing and Metal Coating Industries by the railway car appliances industries, has selected the following members as its code authority: William E. Sharp, president of the Grip Nut Company, Chicago; S. L. Beymer, secretary-treasurer of the Hutchins Car Roofing Company, Detroit, Mich.; G. N. DeGuire, assistant to the president, Locomotive Firebox Company, New York; A. C. Moore, president, Chicago Railway Equipment Company, Chicago; and H. S. Kimball, Fabricated Metal Products Federation, Washington, D. C. Elmer M. Naylor, vice-president, Naylor Pipe Company, Chicago, is the administration member of the code authority.

A. L. CLARK has been elected president of the American Brake Shoe & Foundry Company of California, San Francisco, Cal., to succeed Thomas Finigan, deceased. Mr. Clark has been actively engaged in the foundry business since 1902, at which time he entered the employ of The American Brake Shoe & Foundry Company as chief clerk at its Mahwah, N. J. plant, having previously been in the employ of the sterling Iron & Railway Company as storekeeper. He later served in the accounting department and became traveling auditor, and in 1905 entered the operating department as assistant to the general superintendent. In 1909 he was appointed superintendent of the Norwood, Mass., plant, and three years later superintendent of the new Chicago plant. In 1913 he was promoted to the position of general superintendent of western foundries, and during the war period was acting works manager. In 1921 Mr. Clark was appointed general manager of The American Brake Shoe & Foundry Company of California, and in 1922 was elected vice-president, which position he continued to hold until his election as president.

THE CHILLED CAR WHEEL INDUSTRIES, through the Association of the Manufacturers of Chilled Car Wheels, has elected the following as members of its code authority: D. H. Sherwood, president of the association and vice-president of the Maryland Car Wheel Company; W. F. Cutten, president of the Southern Car Wheel Company; J. L. Kilpatrick, president of the Albany Car Wheel Company and the Reading Car Wheel Works; E. P. Waud, vice-president of the Griffin Wheel Company and president of the Cleveland Production Company; and J. M. Keller, manager of foundries of the American Car & Foundry Company. Horace B. Horton, treasurer of the Chicago Bridge and Iron Works, Chicago, has been appointed administration member of the code authority by the N.R.A.

Obituary

I. H. BOWEN, railroad department representative of the Dearborn Chemical Company, at Denver, Colo., died recently.

CHARLES E. HALE, for many years connected with the sales organization of the Baldwin Locomotive Works, died at Philadelphia, Pa., on April 16.

BENJAMIN F. OTLEY who retired as president and general manager of the Otley Paint Manufacturing Company, Chicago, in 1918, died in that city on April 5, following a cerebral hemorrhage.

JOSEPH H. KUMMER, general sales representative of the Fort Pitt Malleable Iron Company, with headquarters at Pittsburgh, Pa., died of heart failure in New York on March 18. Mr. Kummer was born in Detroit, Mich., on July 2, 1881, and at an early age became associated with the Fort Pitt Malleable Iron Company.

ALFRED J. JUPP, a vice-president of the Lunkenheimer Company, Cincinnati, Ohio, died suddenly in Roosevelt Hospital, New York, on April 10, while on a business trip. Born in Cincinnati on June 25, 1875, Mr. Jupp entered the employ of the Lunkenheimer Company in May, 1890. In 1896 he was made New York representative, returning to the home office in Cincinnati in 1913. Mr. Jupp was active in the Manufacturers' Standardization Society and also contributed the greater part of his time during recent months to code work in the valve and fittings industry.

WILLIAM HARTMAN WOODIN, formerly president of the American Car & Foundry Company and chairman of the Board of directors of the American Locomotive Company, and until his resignation on January 1, 1934, secretary of the treasury in the cabinet of President Franklin D. Roosevelt, died at a hospital in New York on May 3. Mr. Woodin was born at Berwick, Pa., on May 27, 1868. He was a descendant of a family which has been associated with railway car building practically since the inception of that industry in this country. In 1849 his grandfather, after whom he was named, entered a partnership with Mordecai W. Jackson to establish at Berwick, Pa., a foundry under the firm name of Jackson & Woodin for the manufacture of stoves, plows, iron pipe and other foundry products. In 1861 this business was extended to include the manufacture of cars and in 1872 it was absorbed by a new company known as the Jackson & Woodin Manufacturing Company. This latter was one of the firms which in 1899 were merged to form American Car & Foundry Company. Mr. Woodin received a technical education at the Columbia University School of Mines which he attended with the class of 1890. Upon leaving college he entered the shops of the Jackson & Woodin Manufacturing Company at Berwick and in 1892 was appointed general



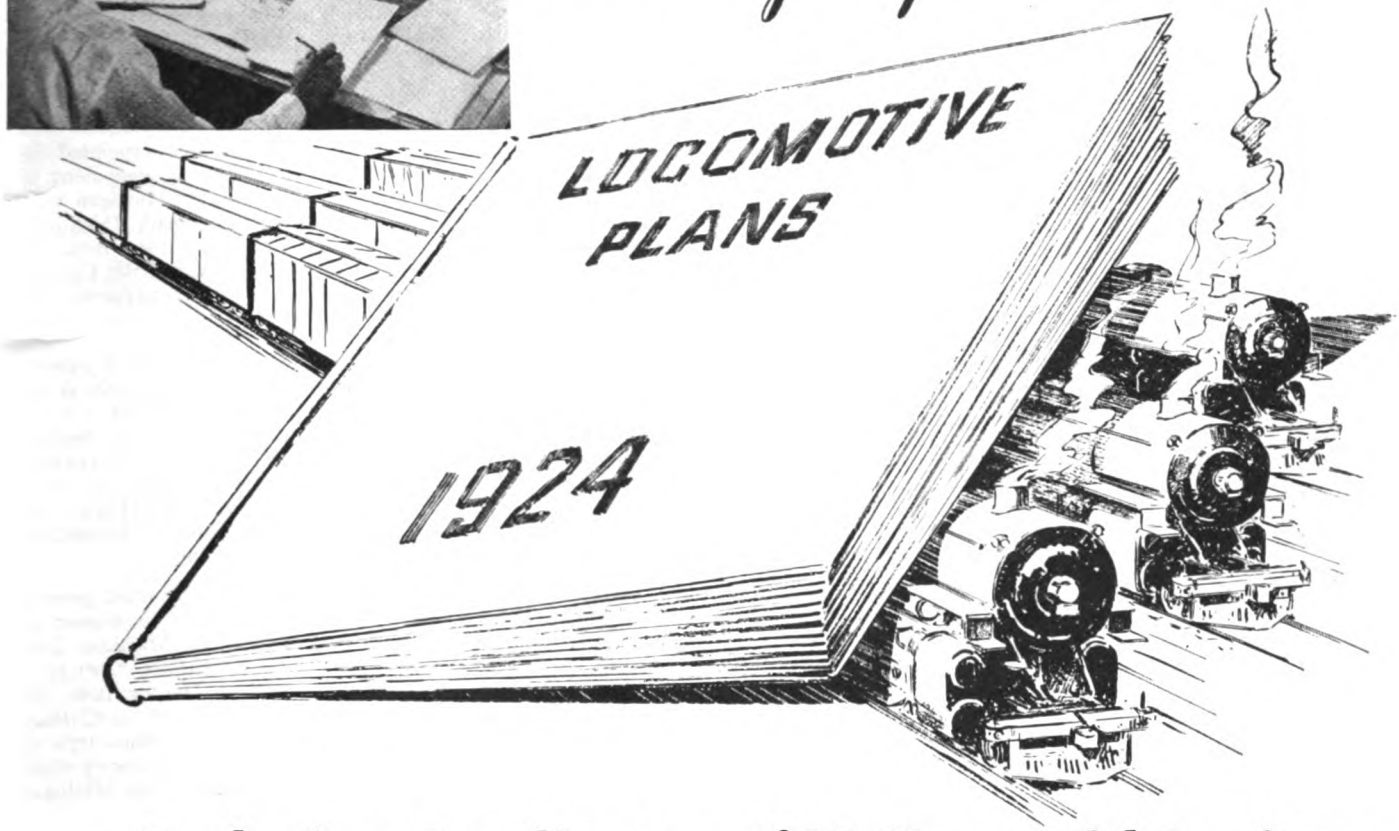
W. H. Woodin

superintendent of that plant. Three years later, in 1895, he was elected vice-president and his promotion to the presidency came in 1899. With the merging of the plant into the American Car & Foundry Company in the latter year, Mr. Woodin was appointed district manager of the Berwick plant. He next became assistant to the first vice-president of the new company and in 1902 he was appointed a director and assistant to the president, having general direction of the company's affairs under President Frederick H. Eaton, whom, on February 1, 1916, Mr. Woodin succeeded in the presidency. Mr. Woodin first became president of the American Locomotive Company in December, 1925, succeeding the late Andrew Fletcher. In May, 1926, however, he temporarily relinquished the position and was succeeded by Frederick F. Fitzpatrick, former president of the Railway Steel-Spring Company. After the death of Mr. Fitzpatrick in November, 1927, Mr. Woodin was again the American Locomotive Company's president until April, 1929, when, remaining as chairman of the board, he was succeeded in the presidency by William C. Dickerman. Mr. Woodin also held offices in companies affiliated with the American Car & Foundry Company and the American Locomotive Company.

(*Turn to next left-hand page*)



Use Modern Standards in Designing New Power

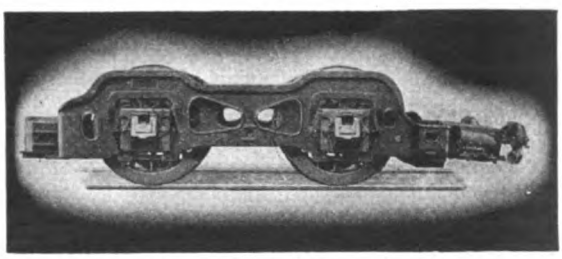


Ordering Duplicates of 10 Year Old Designs Places New Locomotives Under a Handicap

Obsolescence determines the effective life of equipment. If the art of ten years ago is used as the basis for designing new locomotives, there is ten years' obsolescence before the equipment ever goes to work.

When purchasing new locomotives for any service, determine the power requirements for both high and low speeds, then meet these requirements with an engine having the minimum weight on drivers. Include The Locomotive Booster as an integral part of the design.

Compared with non-Booster engines for the same requirements, there is a substantial saving in maintenance expense as well as first cost, because you can have a smaller cylinder and do the same work.



FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

Personal Mention

General

G. C. SEIDEL has been appointed superintendent of motive power of the Missouri & North Arkansas, with headquarters at Harrison, Ark.

J. J. PRENDERGAST, assistant mechanical superintendent of the Texas & Pacific, has been appointed acting mechanical superintendent, with headquarters as before at Dallas, Tex.

M. W. HASSETT has been appointed assistant superintendent of equipment of the New York Central (Buffalo and East) with headquarters at New York. Mr. Hassett was formerly assistant superintendent of motive power, which position has been abolished.

E. C. RICHARDS has been appointed assistant superintendent of equipment of the Michigan Central, with headquarters at Detroit, Mich. Mr. Richards was formerly superintendent of rolling stock of the Michigan Central at Detroit, which position has been abolished.

B. F. KUHN has been appointed assistant superintendent of equipment of the New York Central (West of Buffalo) and the Ohio Central Lines, with headquarters at Cleveland, Ohio. Mr. Kuhn was formerly assistant superintendent of motive power of these lines, which position has been abolished.

JAMES H. WILSON, chief electrician of the Norfolk Southern with headquarters at Norfolk, Va., has been appointed chief mechanical inspector and assistant to superintendent of motive power, with the same headquarters. Mr. Wilson will assume the duties of the late Herbert Smith Fentress, general car inspector.

J. W. SENGER has been appointed assistant superintendent of equipment of the New York Central (West of Buffalo) and the Ohio Central Lines, with headquarters at Cleveland, Ohio. Mr. Senger was formerly superintendent of rolling stock of these lines at Cleveland, which position has been abolished.

W. J. O'BRIEN has been appointed district assistant superintendent of equipment of the Ohio Central Lines of the New York Central, with headquarters at Columbus, Ohio. Mr. O'Brien was formerly district superintendent of motive power and rolling stock of the Ohio Central Lines at Columbus, which position has been abolished.

A. E. CALKINS has been appointed superintendent of equipment of the New York Central (Buffalo & East), with jurisdiction over the motive power and rolling stock departments (other than shop operation), with headquarters at New York. Mr. Calkins was formerly superintendent of rolling stock at New York, which position has been abolished.

J. A. BROSSART has been appointed assistant to general superintendent of rolling stock, with jurisdiction over freight and passenger-car shop operations, of the New York Central, the Michigan Central and the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at New York. Mr. Brossart was formerly superintendent of rolling stock of the C. C. C. & St. L. at Indianapolis, Ind.

R. M. BROWN has been appointed assistant to general superintendent of motive power of the New York Central, the Michigan Central and the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at New York. Mr. Brown was formerly superintendent of motive power of the New York Central at New York, which position has been abolished.

J. F. JENNINGS has been appointed superintendent of equipment of the Michigan Central, with jurisdiction over the motive power and rolling stock departments (other than shop operation), with headquarters at Detroit, Mich. Mr. Jennings was formerly superintendent of motive power of the Michigan Central at Detroit, which position has been abolished.

JOS. CHIDLEY has been appointed superintendent of equipment of the New York Central (West of Buffalo) and the Ohio Central Lines, with jurisdiction over the motive power and rolling stock departments (other than shop operation), with headquarters at Cleveland, Ohio. Mr. Chidley was formerly superintendent of motive power of these lines at Cleveland, which position has been abolished.

E. M. WILCOX has been appointed superintendent of equipment of the New York Central, the Michigan Central, the Cleveland, Cincinnati, Chicago & St. Louis, the Indiana Harbor Belt, the Chicago River & Indiana, and the Chicago Junction Railway, with jurisdiction over the motive power and rolling stock departments, with headquarters at Chicago. Mr. Wilcox was formerly master car builder of the New York Central (West of Buffalo), the Michigan Central, the Indiana Harbor Belt and the Chicago River & Indiana, which position has been abolished.

Master Mechanics and Road Foremen

P. R. FRISBEE has been appointed road foreman of engines of the Buffalo division of the Erie.

L. D. BURDELL has been appointed road foreman of engines of the Susquehanna division of the Erie.

W. G. MCCLURE has been appointed road foreman of engines of the Kent division of the Erie, with headquarters at Marion, Ohio.

W. P. HARTMAN, fuel supervisor of the Atchison, Topeka & Santa Fe at Amarillo, Tex., has been promoted to the position of master mechanic, with headquarters at Slayton, Tex.

J. W. MCCARTHY, road foreman of engines of the Susquehanna division of the Erie, has been appointed chief road foreman of engines of the Susquehanna and Delaware divisions.

J. D. SHEEHAN has been appointed master mechanic of the New York Central, the Michigan Central, the Cleveland, Cincinnati, Chicago & St. Louis, the Indiana Harbor Belt, the Chicago River & Indiana and the Chicago Junction Railway, with headquarters at Chicago. Mr. Sheehan was formerly master mechanic of the New York Central (West of Buffalo), Elkhart, Ind.

Car Department

E. H. BURGESS has been appointed inspector of air conditioning equipment of the New York Central, the Michigan Central, the Cleveland, Cincinnati, Chicago & St. Louis, the Indiana Harbor Belt, the Chicago River & Indiana, and the Chicago Junction Railway, with headquarters at New York.

C. HOUSER has been appointed general car foreman of the New York Central, the Michigan Central, the Cleveland, Cincinnati, Chicago & St. Louis, the Indiana Harbor Belt, the Chicago River & Indiana, and the Chicago Junction Railway, with headquarters at Chicago. Mr. Houser was formerly foreman inspector of the Indiana Harbor Belt at Gibson, Ind.

F. J. HILL has been appointed general supervisor of car electric equipment of the New York Central, the Michigan Central, the Cleveland, Cincinnati, Chicago & St. Louis, the Indiana Harbor Belt, the Chicago River & Indiana, and the Chicago Junction Railway, with headquarters at New York. Mr. Hill was formerly chief electrician, car department of the Michigan Central at Detroit, Mich.

Shop and Enginehouse

C. R. SWANSON, a machinist on the Union Pacific at North Platte, Neb., has been promoted to the position of drop pit foreman.

AUSTIN R. SNYDER, a machinist on the Union Pacific at North Platte, Neb., has been promoted to the position of night enginehouse foreman.

ALBIN C. PETTERSON, night enginehouse foreman of the Union Pacific at North Platte, Neb., has been promoted to the position of day enginehouse foreman.

WALTER R. LYE has been appointed superintendent of shops of the New York Central (West of Buffalo), with headquarters at Collinwood, Ohio. Mr. Lye was formerly district superintendent of motive power of the same lines, which position has been abolished.

Obituary

W. H. DOOLEY, formerly superintendent of motive power of the Southern, died on April 30.

HERBERT SMITH FENTRESS, general car inspector of the Norfolk Southern, with headquarters at Norfolk, Va., died of a cerebral hemorrhage at his home in Norfolk, on March 13, at the age of 68.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

June, 1934

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices,
30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: Terminal Tower
Washington: 832 National Press Bldg.
San Francisco: 58 Main St.

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Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States and possessions: 1 year, $3; 2 years, $5. Canada, including duty: 1 year, $3.50; 2 years, $6. Foreign countries: 1 year, $4; 2 years, $7.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.

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Founded in 1832 as the American Rail-Road Journal

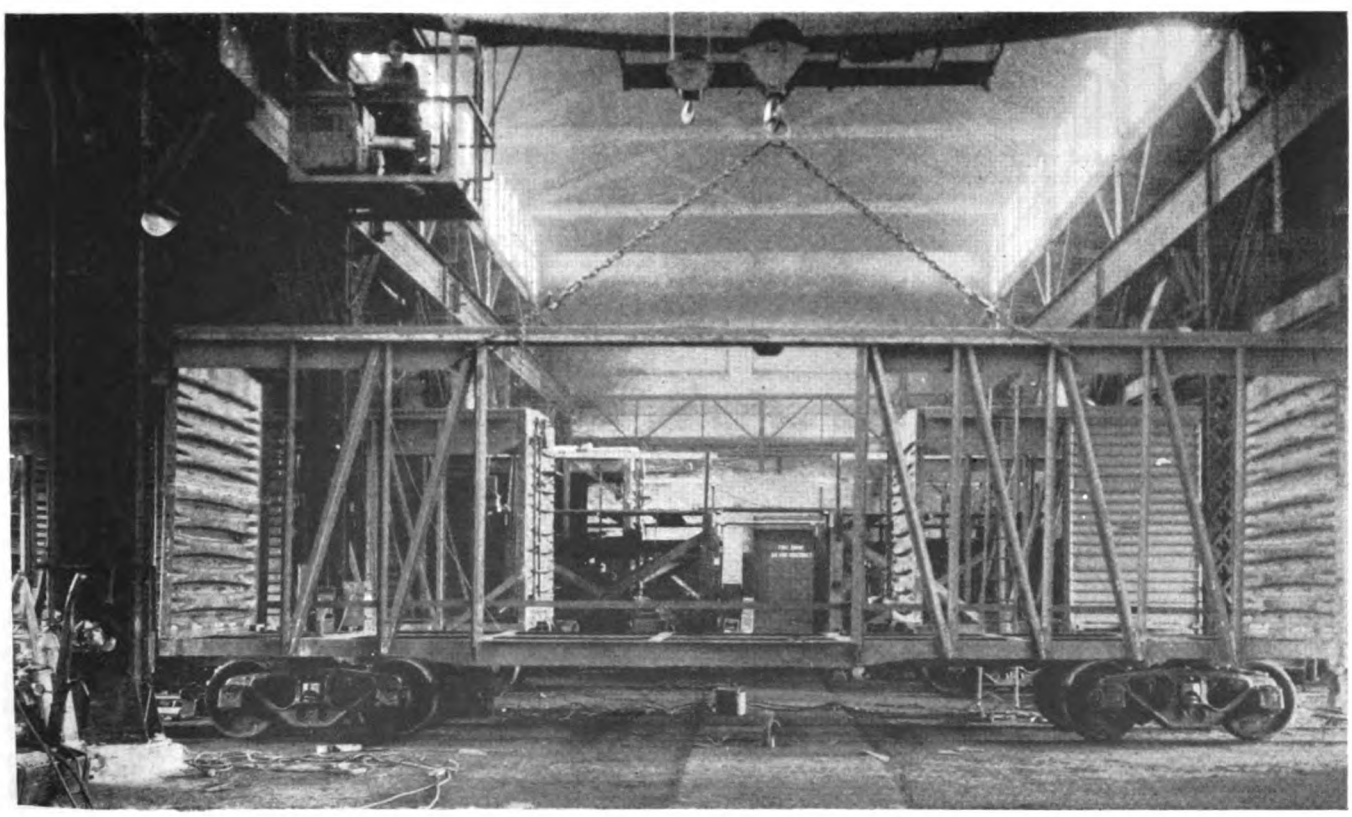
June - 1934

Pittsburg Shops Equipped To Build Automobile Box Cars

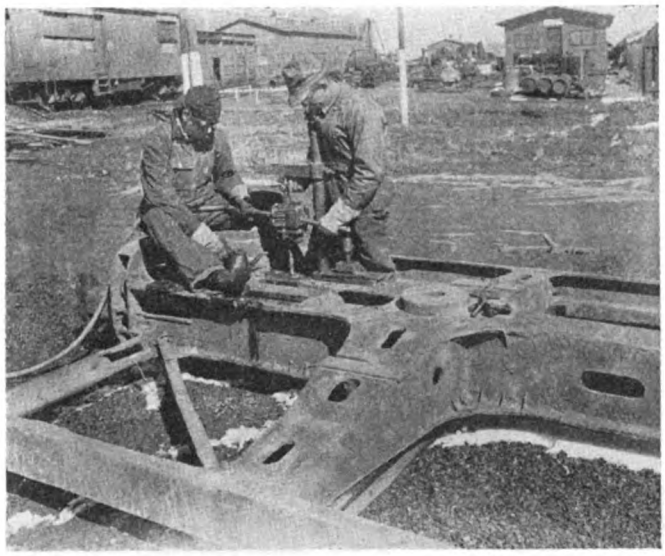
Kansas City Southern completes construction of cars having cast-steel underframes and all-welded upper frames

ONE HUNDRED 40-ton, wood, single-sheathed, automobile box cars, notable as the first cars of this type equipped with cast-steel underframes, all-welded steel upper frames and a modern automobile-loading device, were recently constructed at the Kansas City Southern shops, Pittsburg, Kan. The local shop facilities, which were used effectively in building these cars, included a steel car shop, equipped with a Shaw 30-ton over-head traveling crane in the center bay, a large wood shed with permanent scaffolding, modern lighting facilities, pneumatic tools, electric welding equipment, etc. This welding equipment consists of one General Electric 400-amp., two-lead, welding machine, driven by a Buda gasoline engine; two Westinghouse 200-amp., one-lead, portable, all-electric welding machines; and one lead taken from a stationary 400-amp. welding machine in the locomotive shop. Sureweld extruded shielded-arc electric welding rod was used, all welding being done, so far as possible, in special jigs and using special holding clamps which will be described later.

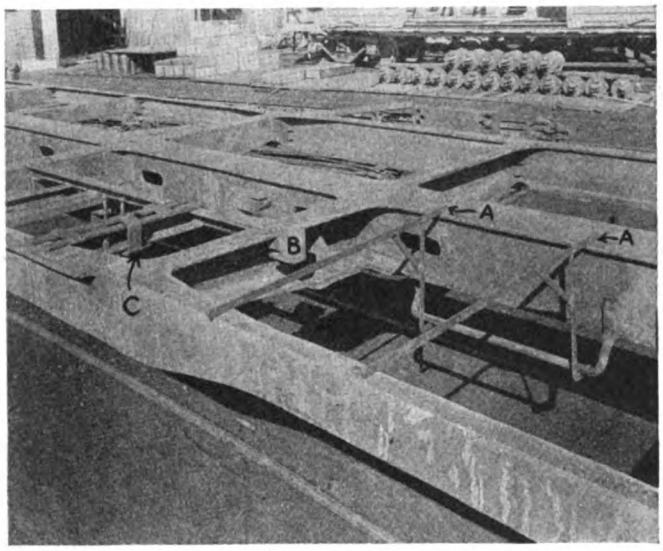
The limiting factor in the welding operations was the fabrication of the side frames, and this job was operated



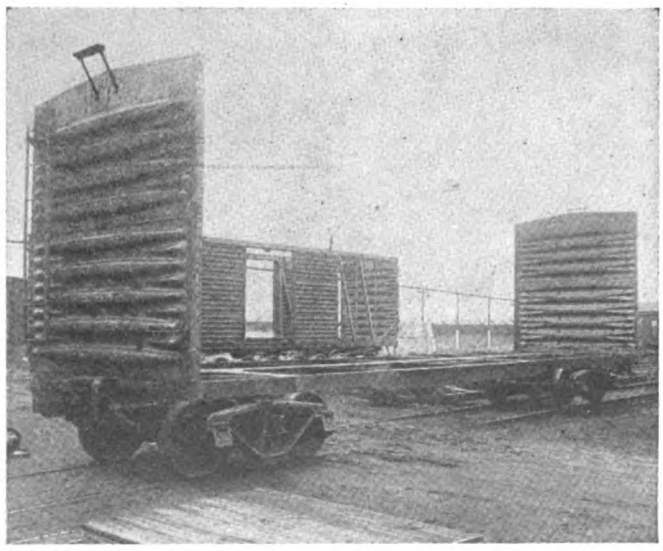
Applying a side frame to the K. C. S. car with the shop crane



Drilling the inverted cast-steel underframe



Gages *A*, *B* and *C* used in properly positioning various parts before welding



Underframe mounted on trucks with ends applied

on two shifts, using 9 welders, 5 on the day shift and 4 on the night. After the work was fully organized, a maximum production of 10 cars a week was obtained. A total of about 600 lin. ft. of welding and 65 welder-hours per car were required. On an average, 106.5 lb. of welding rod were used per car, about 39 per cent being of the ¼-in. size, used on all horizontal jig work, such as the fabrication of the car sides; 59 per cent being the $\frac{5}{32}$-in. size for applying posts and braces, side plates, etc.; and about 3 per cent being the ⅛-in. size, used in overhead welding, such as sealing the joints over the door hoods.

Particular attention was paid to the selection of welders for this work, men being chosen so far as possible who had experience on the all-welded hopper-bottom gondolas previously built at Pittsburg shops. These men were required to make specimen test welds periodically, the welds being pulled and the men rated in accordance with the results, thus giving an opportunity to correct unsatisfactory practice and improve the general standard of welding operation. Tests were also made in the K. C. S. physical laboratory at Pittsburg to determine the comparative strength of conventional riveted construction and electric-welded connections similar to those used in building the automobile cars. These tests are reported to have shown that a 2-in. length of continuous ¼-in. fillet weld is approximately equal to the strength of one ¾-in. rivet in single shear.

In the car structure, the junction of each side post and brace with the side sill is made with a combined length of approximately 24 lin. in. of ¼-in. fillet weld and, in addition to this, a gusset effect is produced at the junction of the flange of the Z-section brace with the flange of the Z-section post at the bottom by shearing the flange diagonally for a distance of 12 in. and electric welding these flanges together. The junction of each side post and brace with the side plate extension plate is made with a combined length of approximately 40 lin. in. of ¼-in. fillet weld.

Method of Constructing the All-Welded Cars

The Commonwealth cast-steel underframes are unloaded upside down immediately south of the steel car erection shed. In this position, holes are drilled in the frames for the draft-gear carrier and brake-cylinder bolts, and the draft gears and draft-gear carriers are applied. The frame is then picked up, turned right side up and set on its permanent trucks, the trucks having been previously assembled complete with brake rigging.

The underframe is then moved into the steel erection shop and a 3-in. by 3-in. by ¼-in. angle welded across the top of each end sill with the back of the angle toward the outside of the car, these angles being used to form a substantial connection between the underframe and the steel ends. The Dreadnaught two-piece steel ends, previously assembled, are then raised into position, squared, and tack-welded in place.

The steel superstructure frames are assembled and welded together on a special jig constructed in such a manner as to insure all parts of the side framing being located in the correct positions. This jig, as shown in one of the illustrations, is composed of three 12-in. structural channels placed parallel to each other and extending slightly longer than the extreme length of the side plate. The channels, after being spaced transversely to support properly the framing when assembled, are secured to Z-bar supports by electric tack welding. This transverse spacing of the two outer channels also gages the distance from the side plate to the bottom ends of the side posts and braces. The longitudinal spacing of the posts and

braces is taken care of by means of spacer blocks welded to the channels. The entire jig, carefully squared and levelled, is mounted upon four shop push cars.

While the fitting up and welding of the framing is being completed on the car, the intermediate floor supports are applied as well as the end-sill grab irons, sill steps, all brake equipment and piping and all other underneath work except the application of the auto-loader floor wells.

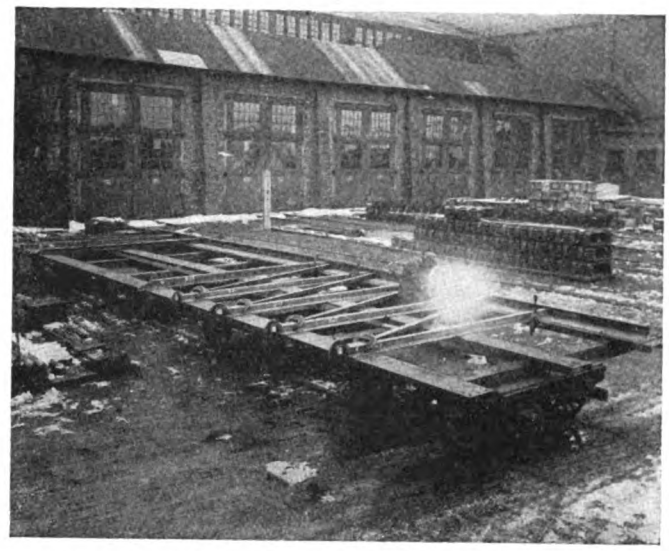
The Youngstown doors are then hung in place and the door tracks applied to the car, the track brackets being secured to the track and to the side sill with 5/8-in. rivets. The doors on each side of the car consist of one main and one auxiliary door, each approximately 6 ft. wide and supported upon a channel-section track with depressions under each door roller in the closed and wide-open positions to relieve the rollers of the weight of the doors when the doors are in either the closed or wide-open position. A lever lifting device is used as a door starter and to lift the rollers out of the depressions. This door-operating mechanism is of the Duplex type furnished by the Railway Metal Products Company.

After the application of the doors is completed, the automobile loading device is loaded into the car and the car switched to the steel finishing track, around which a permanent wide scaffold has been built to facilitate the application of the Murphy all-steel roof. The roof, consisting of 12 sections of No. 13 B. w.g. galvanized steel, extending across the car from side plate to side plate and having a pitch of 6 in. from center of car to eaves, is applied to the car, 3/8-in. rivets being used to secure the edge of the roof sheets to the side plate and to the steel ends. The roof seam caps consist of 3/16-in. steel pressings which are riveted in place as are the steel running-board saddles. While the roof is being assembled, the loader is applied to the steel framing of the car.

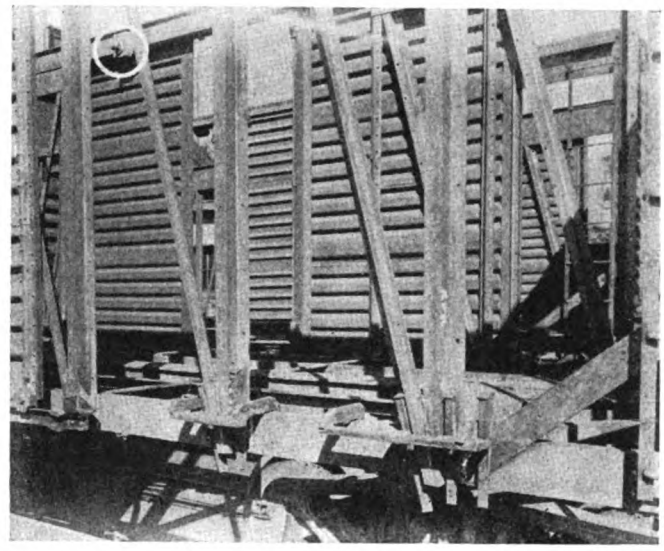
The application of the roof and the loader complete the work done in the steel car shed and the car is then switched to the wood shed lead track where all the weld beads and any rust spots on the framing are sand-blasted, after which all the steel parts are immediately given their respective priming coat of paint or car cement, as required. The sand-blasting of the welds removes the oxidation from the surface of the weld metal that occurs during the welding operation, experience having proven that when the oxidation is not removed it eventually peels off, taking the paint with it.

The car is now ready for application of kiln-dried wood parts and is moved into the wood-finishing shed for completion. The first step in this shed is to secure the bottom sheathing board in place, and, as the bottom edge of this board rests on top of the underframe casting, the contact surfaces at this place are given a liberal coat of Texaco RRX-33 car cement. The decking and the remainder of the side sheathing is then applied along with the end lining nailers and the end lining boards. The side sheathing boards are given a priming coat of paint on the outside surface and on the tongue-and-groove joints prior to their application to the car so that, when assembled in place, the entire car, including both the steel and wood parts, has received the priming coat of paint. The side sheathing boards are secured in place with Leakproof bolts and Grip nuts, the ends of each board being bolted to the steel end flange and the door post and each board bolted alternately to the intermediate posts and braces, the holes for the bolts in the posts and braces and the steel end flanges having been provided in these parts, when purchased.

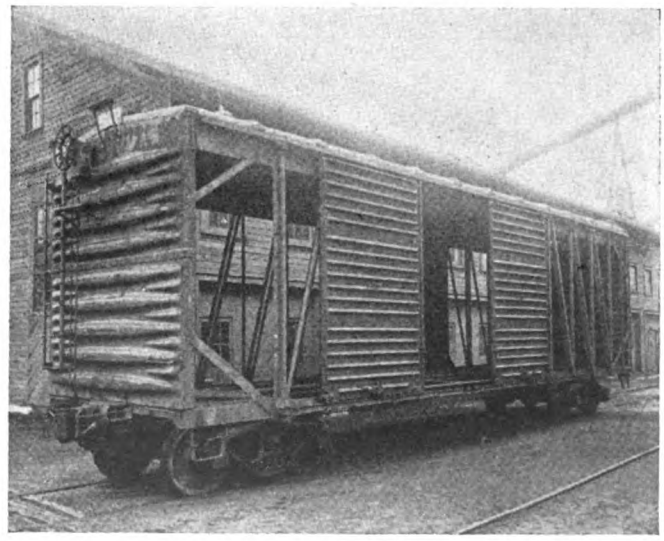
Each decking board is secured to the underframe with four Interlox floor clips, one at each end of the board secured to the side sill flanges and one on each side of



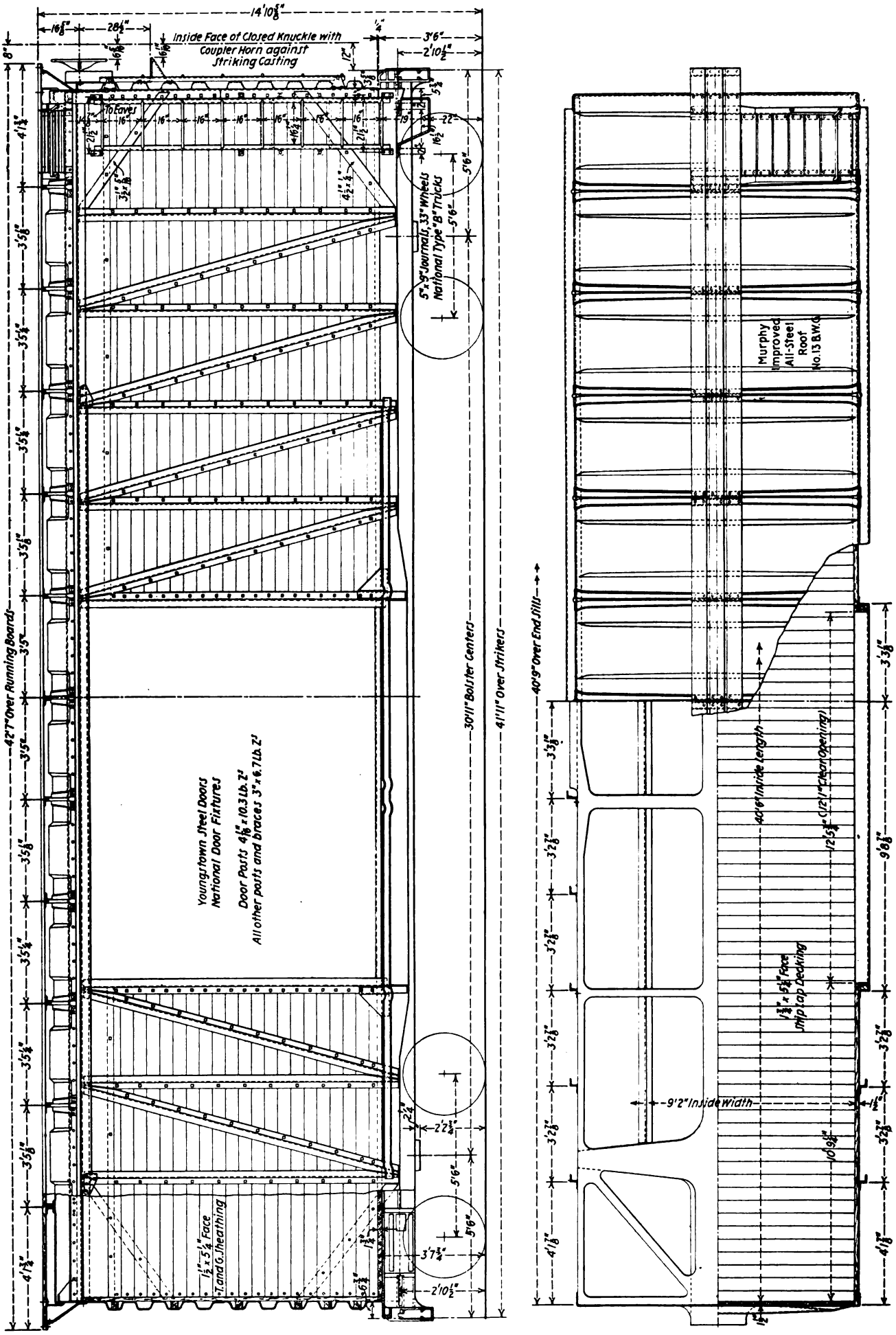
Special jig and clamps used in welding the side frames



Clamps holding side frame in position for welding—circle shows one of the loader fulcrum brackets



Roof and doors applied



Plan, elevation and cross sections of the K. C. S. 40-ton cast-steel underframe all-welded automobile box car

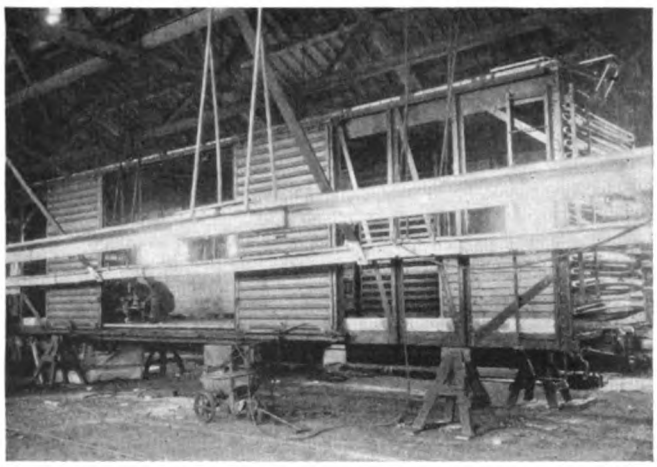
the center sill secured to flanges especially provided on the center-sill casting for this purpose. Throughout the doorways, a pressed-steel threshold plate is provided, the plate extending down over the ends of the boards.

After the decking is laid in place, the auto-loader floor-well locations are marked off by template and the decking cut out at these locations by a shop-made portable air-driven cutter and the wells inserted in place and secured to the underframe casting by U-shaped supports electric welded to the underframe. The application of the post furrings, running boards and placard card boards completes the car except painting and stenciling.

A special Texaco car cement is applied by spraying to the trucks, the cast-steel underframe and the underneath part of the car, and by spray to the outside of the steel roof, one heavy coat completing the work on these parts. The inside of the steel roof is given a priming coat of rust-inhibitive brown paint and a finish coat of non-sweating asphaltum paint, upon which sawdust is heavily sprinkled before the paint is dry. The sawdust functions as an absorbent to prevent condensation from damaging the lading. The remaining steel parts of the car are given a priming coat of rust-inhibitive brown paint all over and two coats of rapid-drying freight-car paint on the outside of the car. The wood sheathing boards are given two coats of rapid-drying freight-car paint.

Principal Features of the Car

The new K. C. S. 40-ton automobile box car is built as high and wide as possible within the recommended American Railway Association clearances for automobile cars and giving due consideration to the special requirements for automobile loading. Each car has an inside length of 40 ft. 6 in., inside width of 9ft. 2 in., and inside height at the side plate of 10 ft. 4 in., giving a cubic capacity of 3,836 cu. ft. This unusually large capacity is obtained by making the inside height 4 in. higher than in most automobile cars recently built. The car has a light weight of 52,200 lb., which includes the cast-steel underframe, weighing about 11,400 lb., and the automobile-loading device weighing approximately 3,200 lb. It is interesting to note, therefore, that this car, equipped with a cast-steel underframe and welded upper frame, weighs less than most other automobile cars of similar capacity, embodying conventional riveted-steel construction, especially if the weight of the loading device is taken into consideration. On the basis of light weight per cu. ft. of capacity, the comparison is especially favorable to the K. C. S. car, which has a light weight of only 13.6 lb. per cu. ft. of capacity.



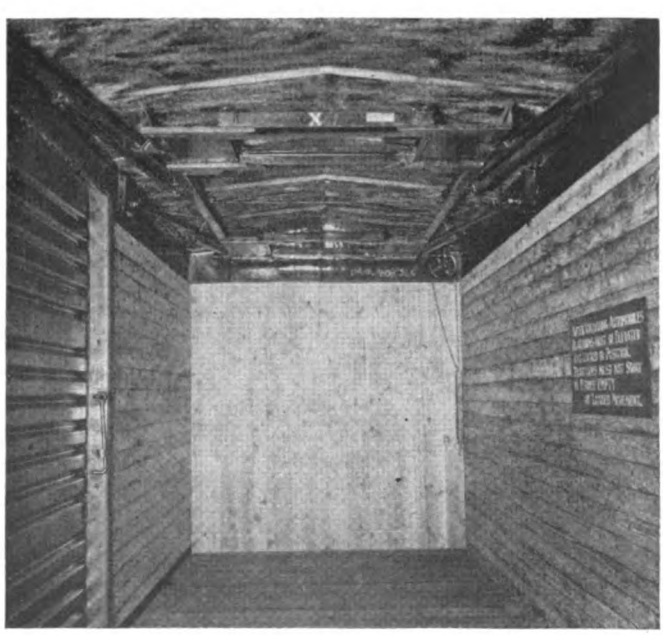
Car temporarily removed from trucks in the wood shed for application of the floor, wood sheathing, automobile loading device, etc.

The underframe and superstructure of the car have been designed to withstand the stresses imposed by a 50-ton load, but due to the fact that the cars are expected to be kept primarily in automobile-carrying service, 40-ton capacity trucks are installed as being amply sufficient for this loading and for almost all other commodities with which box cars are being loaded at the present time. The car can be readily converted to 50-ton capacity if subsequently desired, however, by the application of 50-ton trucks and without any other changes being necessary. The cast-steel trucks installed are of the National, Type-B design, with a wheel base of 5 ft. 6 in., 5-in. by 9-in. journals, and Griffin 33-in. chilled-iron car wheels. Single-roller rocker-type side bearings, supplied by the Wine Railway Appliance Company, are installed. The air-brake equipment is of the new AB-type, furnished by Westinghouse Air Brake Company.

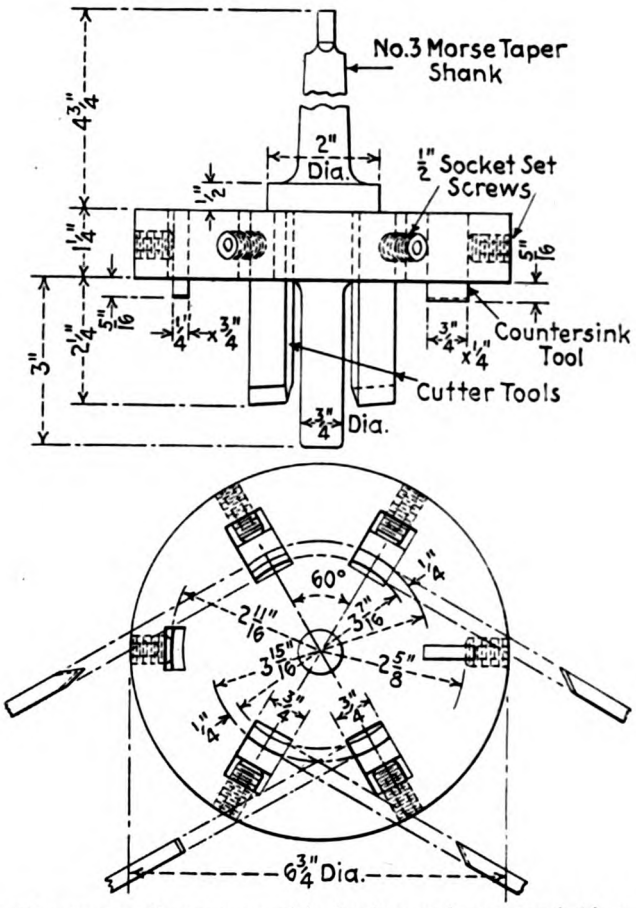
The cast-steel underframe, which greatly simplifies the construction of the car, is a one-piece steel casting with



Car completed, painted and stencilled ready for service



Interior view showing loader in raised position against asphaltum and sawdust painted steel roof



Rotary wood cutter used in boring and countersinking holes for the loader wells

all cross ties, cross bearers, bolsters, end sills, side sills, center plates, striking castings and A. R. A. standard draft pockets and front and rear draft-gear stops cast integral. The center sills and bolster members are of box-section construction and the side and end sills and cross ties are of channel-section construction. The outside surface of the side sills is machine-finished to facilitate application of the posts and braces and the door track brackets. The side sills are 7 in. deep except under doors where they are 10 in. deep to give additional strength at the doorways, and this part of the casting has outward projecting flanges to support the ends of the deck boards at the doorways. The use of this one-piece cast-steel underframe eliminates 1,263 parts, including rivets; and the use of fusion-welding in the superstructure eliminates 1,915 additional parts, including rivets; or a total of 3,178 less parts than in the conventional car.

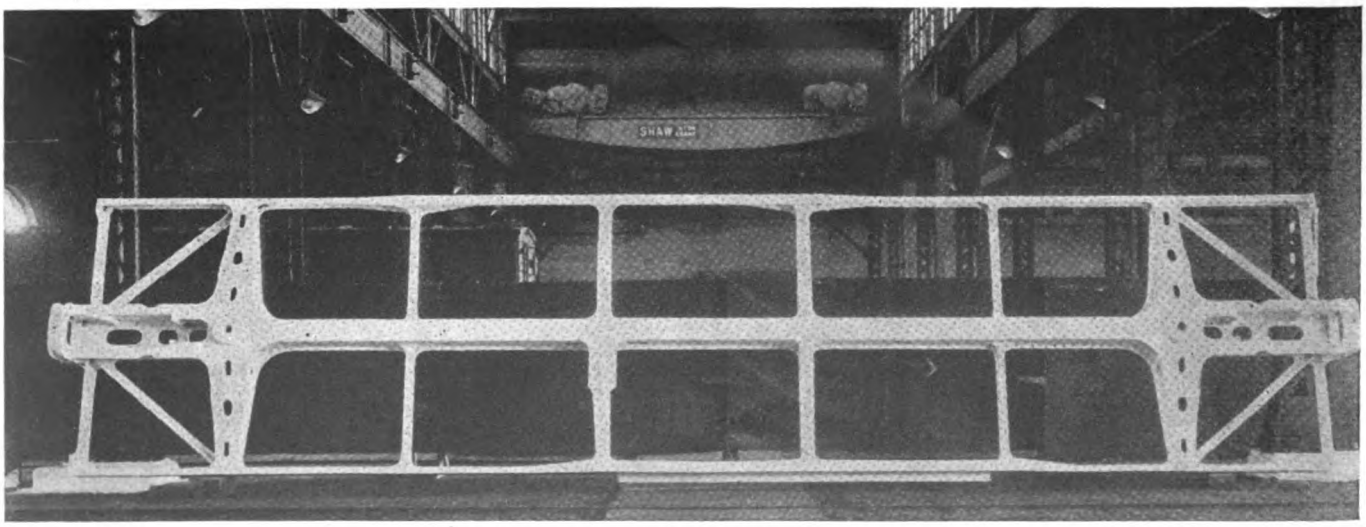
The side framing of the car is in the form of a Howe truss, the vertical and diagonal members consisting of structural Z-section posts and braces and the top horizontal member consisting of a special W-section side plate reinforced by a suitable ¼-in. by 17-in. steel plate, extending downward and cut away to give the required clear door opening. The bottom cord of the truss is formed by the underframe side sill, to which the posts and braces are securely electric welded. The corners of the side framing are strengthened by end diagonals.

The roof is of the solid-steel type, self-supporting and designed to accommodate the automobile-loading device. The corrugated doors, as mentioned, are of the bottom-supported type, with door openings 12 ft. 1 in. wide in the clear and staggered to give a 6-ft. clear opening across the car. Door-post corners are rounded to provide additional opening. The flooring consists of 1-¾-in. by 5-¼-in. face shiplap decking, supported upon the center-sill and side-sill flanges and upon intermediate supports composed of structural Z-section stringers.

The new K. C. S. automobile box car has been subjected to extensive deflection tests under various load conditions with unusually satisfactory results. The underframe deflections, as measured by means of gage wires, were kept within pre-determined limits and no permanent set developed. Impact tests were conducted at speeds up to 18 m. p. h. without damage to the underframe or any welded seams in the superstructure. The favorable performance of the car under these severe test conditions apparently give promise of long car life and freedom from maintenance expenses.

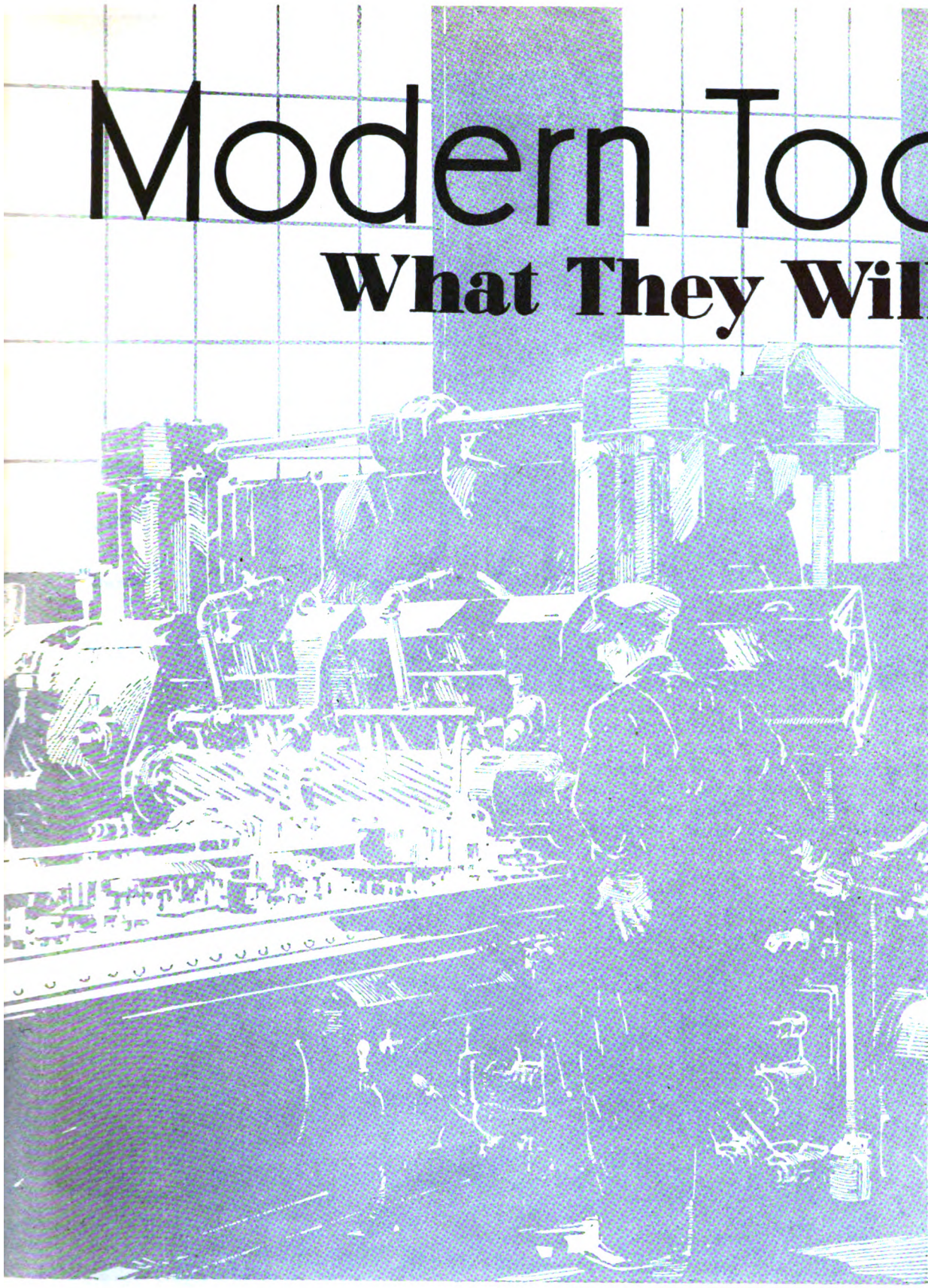
General Dimensions of K. C. S. Automobile Box Car

Length inside	40 ft. 6 in.
Length over buffer castings	41 ft. 11 in.
Truck centers	30 ft. 11 in.
Width inside	9 ft. 2 in.
Width over all	10 ft. 8⅞ in.
Height inside at side plate	10 ft. 4 in.
Height inside at center to panels in roof for about 50 per cent of the length of the roof to provide clearance for automobile radiator caps	11 ft. 0 in.
Height over running board	14 ft. 10⅝ in.
Width of side door opening (in clear)	12 ft. 1 in.
Wheel base of truck	5 ft. 6 in.
Size of journals	5 in. by 9 in.
Diameter of wheels	33 in.
Capacity of car in cubic feet	3,836
Weight of cast-steel underframe	11,400 lb.
Weight of automobile loading device	3,200 lb.
Light weight of car fully equipped	52,200 lb.
Nominal load-carrying capacity	80,000 lb.
Load limit	83,800 lb.

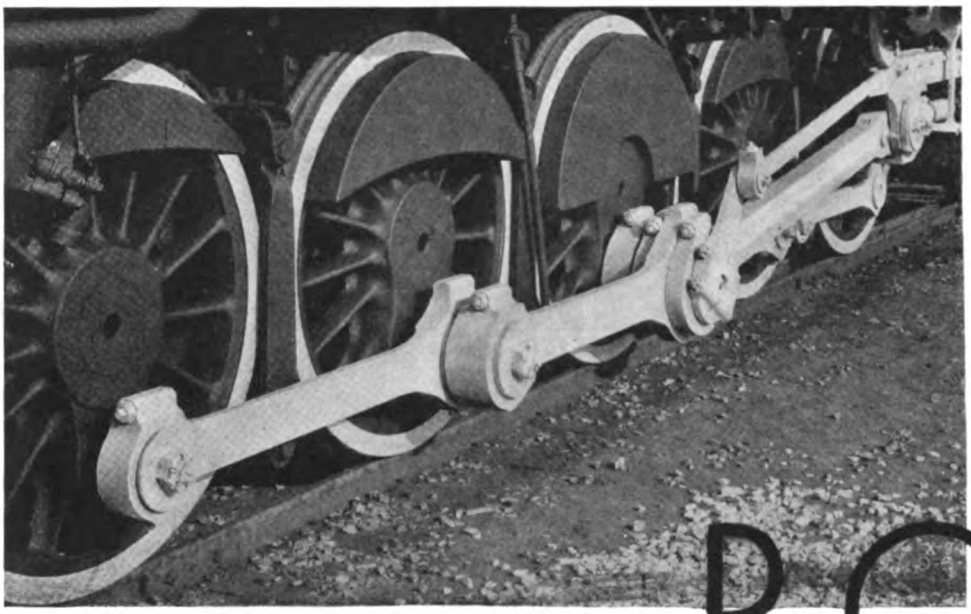


Commonwealth cast-steel underframe in the crane-equipped car shop

Modern Tools
What They Will Do



Progress in machine tool design in recent years has resulted in the production of machines which are capable of doing a much better job in considerably less time than is possible on obsolete tools. In the articles appearing on pages 186 and 190 examples of nine of the most important machine shop jobs are presented with time studies showing what a modern machine will do. A comparison of these with your present operation will enable you to determine what a modern tool can do for you.



MILLING RODS

MACHINING locomotive main and side rods is one of the most important operations involved in locomotive repair work. The average shop turning out from 20 to 40 classified repairs a month will find it necessary to machine from 100 to 200 new main and side rods annually. Practically all of the larger shops have been machining side and main rods on milling machines for several years, but it is recognized that developments in milling machines, in milling cutters and tooling equipment have been of such a nature during the past few years that it is now possible to perform this important machining operation on modern milling machines in considerably less time than on the older machines. A great many shops are still equipped with what may be termed obsolete designs of milling machines, many of which do not have sufficient width of table to mill two or more of many of the present-day designs of locomotive rods at one setting. Neither are these machines designed to take the heavy milling cuts required in finishing the present design and size of rod, nor are the machines equipped with quick clamping universal fixtures. Modern milling machines are required to feed

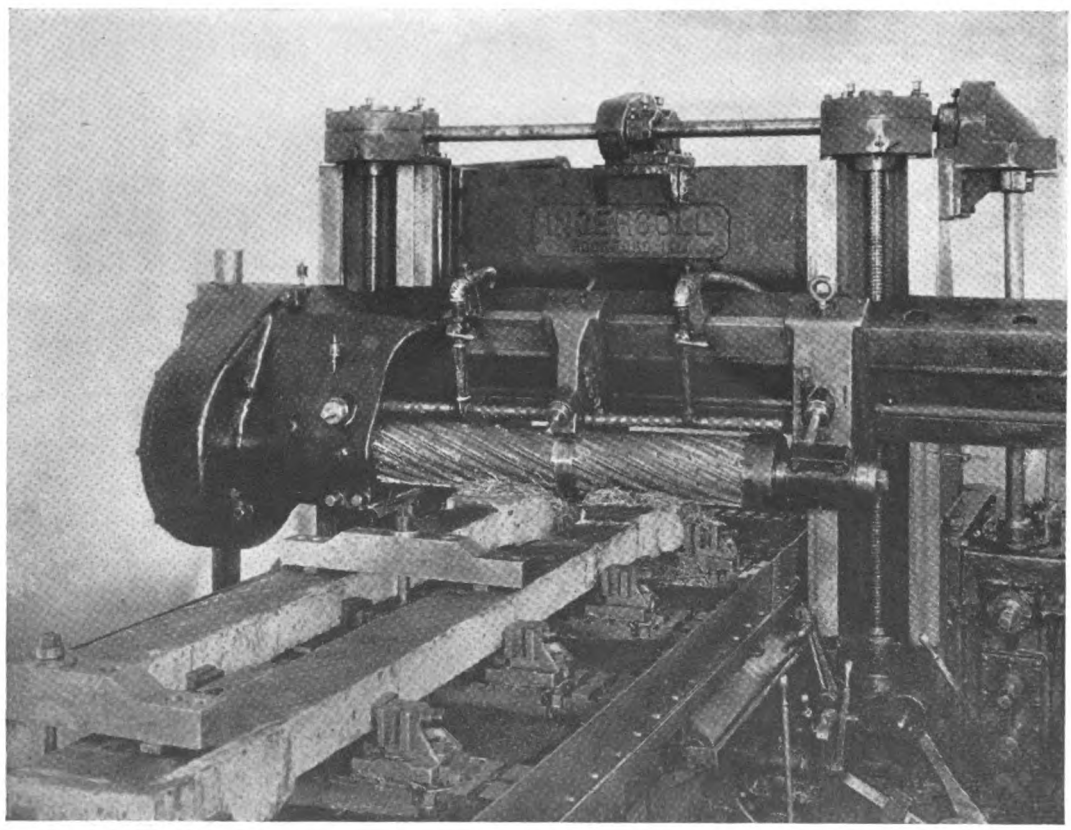


Fig. 1—At the first setting the ends of two rods are finished

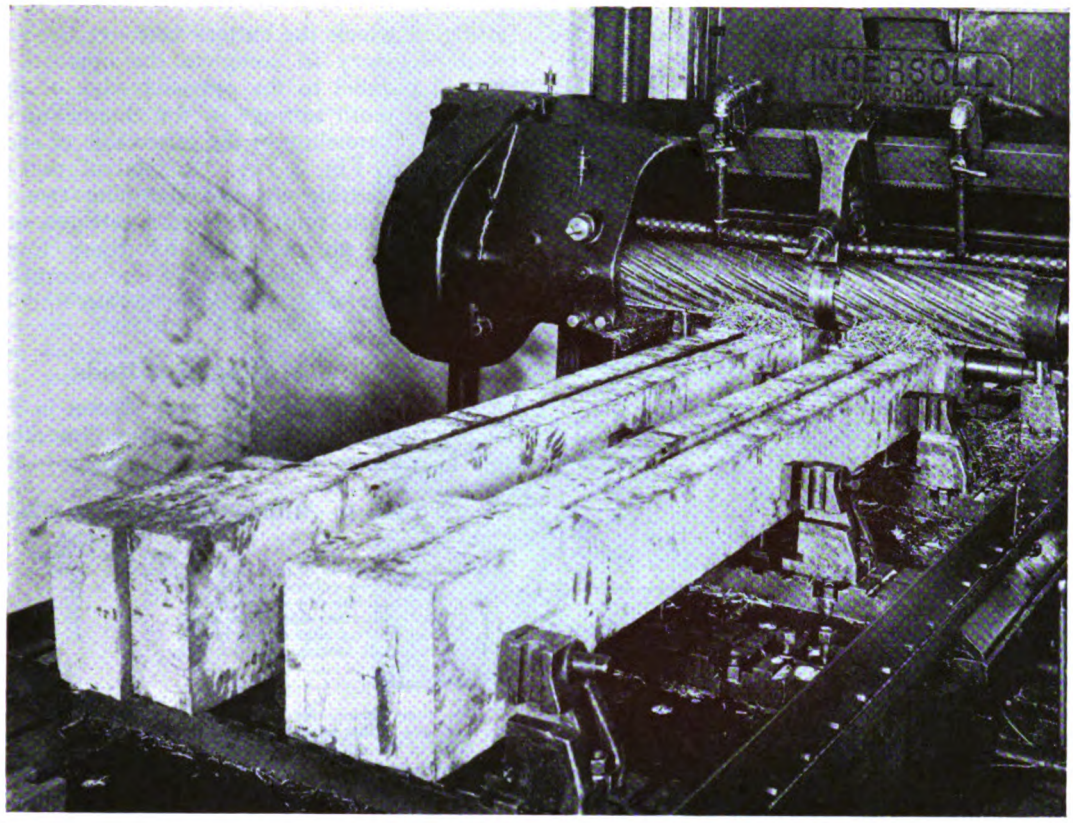


Fig. 2—Slab milling the edges of four main rods at one operation

at a rate of 5½ in. per min., whereas most of the older design machines are capable of feeding at not much over 1 in. per min. on channel milling and 2½ in. per min. on slabbing.

As an example of what can be done on a modern machine with modern tooling equipment detail information is presented giving a comparison of the time involved in the milling operations on carbon vanadium main and side rods on an old machine and on one of the most modern machines available for this class of work. The machine used as the basis for this study is an Ingersoll 54-in. by 30-in. by 16-ft., 75-hp. spindle milling machine equipped with Ingersoll fixtures and cutters.

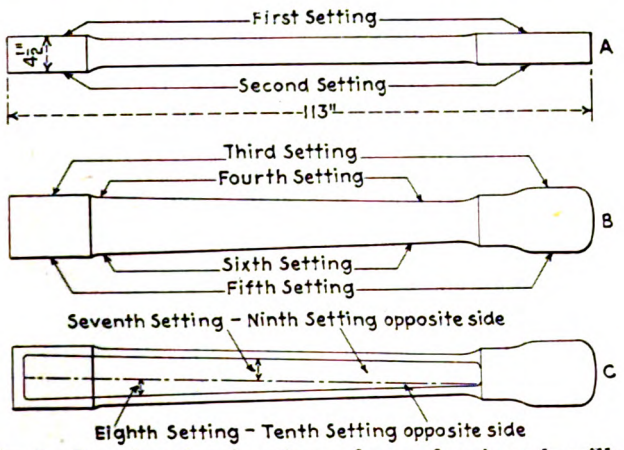


Fig. 3—Drawing showing the surfaces of main rods milled at the several settings

Milling Main Rods

The main rods to be milled are of the conventional strap type, of which many are in service. The overall length of the rod is 113 in. and the time required on one of the old type milling machines to finish this rod, as far as the slabbing and channeling operations are concerned, was 27 hr., floor to floor, as compared with 11.75 hr. on the modern machine, a direct saving in time of 15.25 hr. for one pair of main rods of the type shown. The operations involved in machining these rods on the modern machine include ten separate settings for each pair of rods and the details concerning set-up and milling time are as follows.

Thirty minutes are required for mounting two 9-in. diameter by 24-in. cutters on the arbor of the machine for the first pair of rods and two hours are required to set and clamp two rods for the first and second settings on the machine which involve, respectively, the milling of the top and bottom flat faces of the two rods. This operation is shown in Fig. 1. The actual milling time for the first and second setting is 1.5 hr. for the two

Table I—Milling Operations on Main Rods

Setting no.	Description of operation	Set-up time (per pair of rods) Hr.	Set-up time (per pair of rods) Min.	Milling time (per pair of rods) Hr.	Milling time (per pair of rods) Min.
..	Mounting cutters on arbor for first pair of rods	..	30	..	..
1	Slab milling one side of two rods	1	..	..	45
2	Slab milling other side—two rods	1	..	..	45
3	Slab mill top edges of rod —ends two rods*				
4	Mill top edges of rod body —two rods*				
5	Mill bottom edges of rod ends—two rods*	1	30	..	45
6	Mill bottom edges of rod body—two rods*				
..	Mounting channeling cutters on arbor	..	30	..	..
7	Straight Channel cut	..	30	..	45
8	Taper channel cut—one side, two rods	..	30	..	45
9	Straight channel cut other side—two rods	..	30	..	45
10	Taper channel cut other side —two rods	..	30	..	45
	Total	6	30	5	25

* The time shown for two rods is based upon the assumption that four rods are milled at one operation. Four rods require 1 hr. 30 min. to mill or 45 min. per pair of rods.

rods. The third setting involves the milling of the top edges of both ends of the rod and four rods can be set up on the machine at one time. This operation is shown in Fig. 2. The fourth setting takes care of the milling of the top tapered edge of the body of the rod and the fifth and sixth settings, respectively, involve the milling of similar surfaces on the bottom edges of the four rods. Three hours are required to set up and clamp the four rods for the third, fourth, fifth and sixth

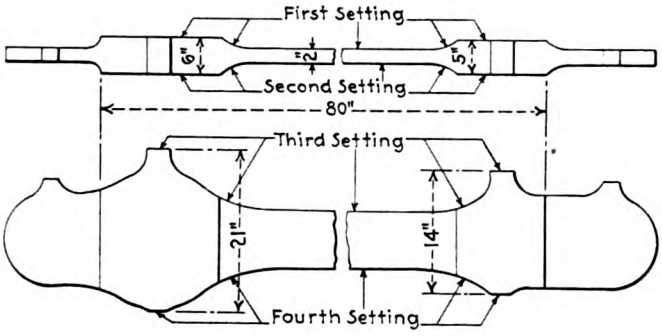


Fig. 4—Four settings are required to finish side rods

settings mentioned, or an average of 1.5 hr. per pair of rods. The actual milling time for the four settings mentioned is a total of 1.5 hr. for the four rods, or .75 hr. per pair of rods.

After these operations are completed the next step is to channel the rods and the machine is set up to mill the channels on two rods at one time. A total of 30 min. is again required for mounting two 10-in. diameter by 3½-in. staggered tooth cutters on the arbor of the machine for the first pair of rods on which this operation is performed. Two settings are required to mill the channels on each side of each rod. The seventh setting in the complete rod milling operation is that in which a channel cut is taken down through the rod parallel to one outer edge. This is shown in Fig. 5. The rods are then moved in the fixtures for the eighth setting in which the cutters take out the remaining material necessary to complete the opposite sides of the channel parallel to the opposite edge of the rod. The ninth and tenth settings of the channeling operation involve the channeling of the other side of each rod. This is shown in Fig. 3 (c). A total of two hours is required for setting up and clamping two rods for the seventh, eighth, ninth and tenth settings, and the actual milling time on two rods for these four settings is three hours. . A summary of the operations on main rods, together with the detail set-up and milling time, is shown in Table I.

Milling Side Rods

The milling of the side rods shown in Fig. 4 on the modern type of rod milling machine illustrated represents four operations involving a total floor-to-floor time for one pair of intermediate side rods of 4.5 hr. This time is one half that required to machine the same rods on an older type machine of the same general type, representing a saving in time per pair of rods of 4.5 hr. The milling work on these rods requires four settings. Preliminary to the actual milling operations 30 min. are required to mount two 9-in. diameter by 24-in. helical inserted tooth cutters on the arbor of the machine and 1.5 hr. are required to set up and clamp two rods in the fixtures; 45 min. setting time for the first setting in which the flat surfaces of both ends and the body of one side of the two rods is machined, and 45 min. more for turning rods over in the fixtures and clamping for mill-

Table II—Milling Operations on Side Rods

Setting no.	Description of operation	Set-up time (per pair of rods) Hr.	Min.	Milling time (per pair of rods) Hr.	Min.
..	Mount two cutters on arbor..	..	30	..	..
1	Slab mill one side of two rods.	..	45	..	30
2	Slab mill other side of two rods.	..	45	..	30
3	Slab mill top edge of two rods*.	..	30	..	15
4	Slab mill bottom edge of two rods*	..	30	..	15
	Total	3	00	1	30

* The time shown for two rods is based upon the assumption that four rods are milled at one operation. Four rods require one hour to mill or a total of 30 min. per pair of rods.

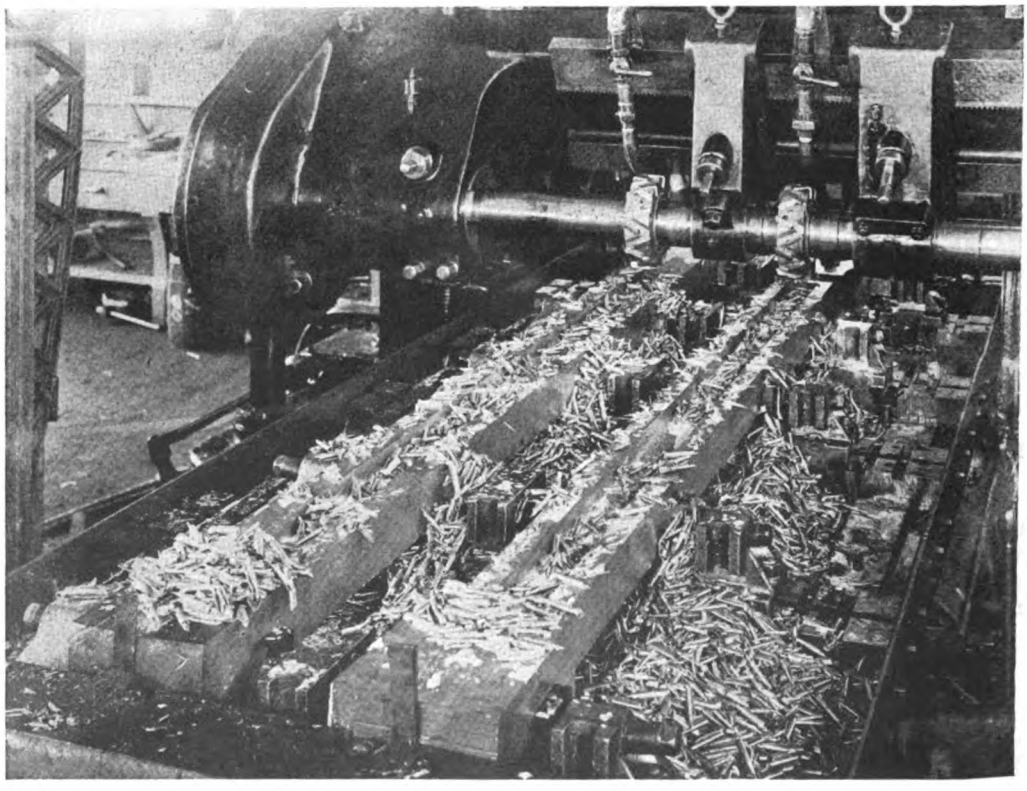


Fig. 5—Two passes of the channeling cutters are necessary to mill the tapered channels on each side of the main rods

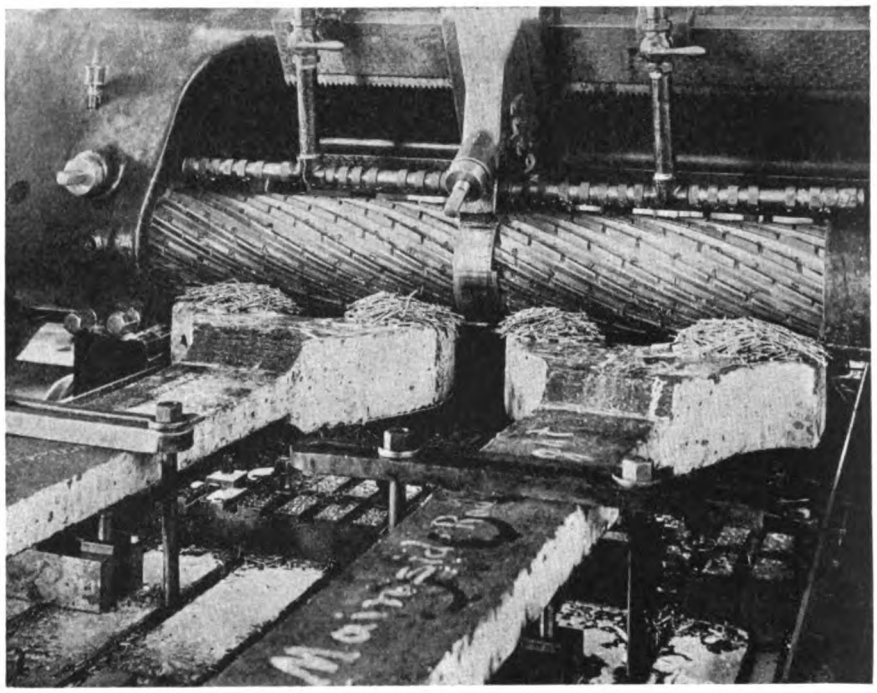


Fig. 6—Side rods are finished in four settings on the machine. The first, shown here, finishes the flat sides of the rods at one operation, using two cutters

ing the flat surfaces of the other sides of the rods. The actual milling time for both sides of these rods is 60 min. Fig. 6 shows the operation on the flat sides of the rods. Having completed the machining of the flat surfaces of the rods, the milling of the edges of the rods is next performed. In this operation as many as eight rods may be set up on the table of the machine at one time. One hour is required for setting up and clamping four rods in the fixtures (30 min. for two rods) for the third setting at which the top edges are milled. The actual milling time at the third setting is 15 min. per pair of rods. After the completion of the work at the third setting the rods are turned over in the fixtures and clamped for the milling of the other edge of the four rods. This is the fourth and final setting. One hour setting-up time is required for four rods on the fourth setting (30 min. for two rods) and 15 min. are required for each pair of rods for milling the other edges of the rods. A summary of the operations, together with the details of the set-up and milling time, is given in Table II.

As previously mentioned, the principal reasons why a modern design of rod milling machine is able to perform milling operations such as these is that the machine itself has a capacity not only to mill more rods at one time than is possible with the older machines, but also is equipped with special fixtures and cutters that make it possible to reduce the set-up time and to speed up the actual feeding of the cutters into the work at a rate not possible on the older machines.

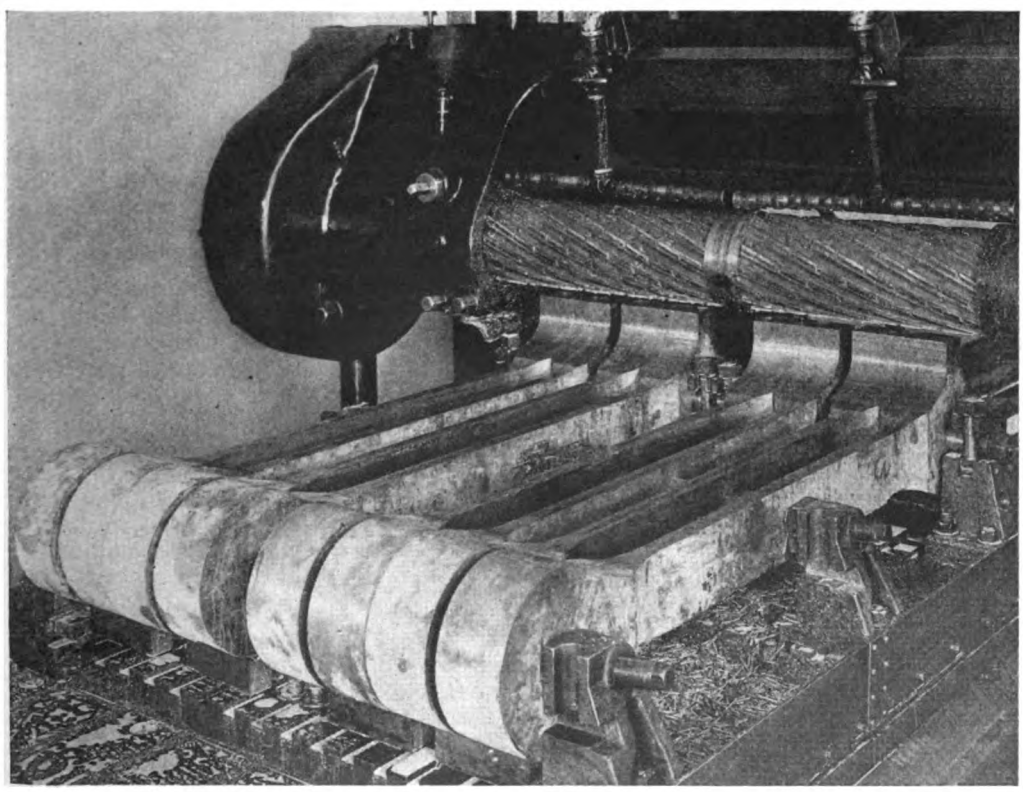
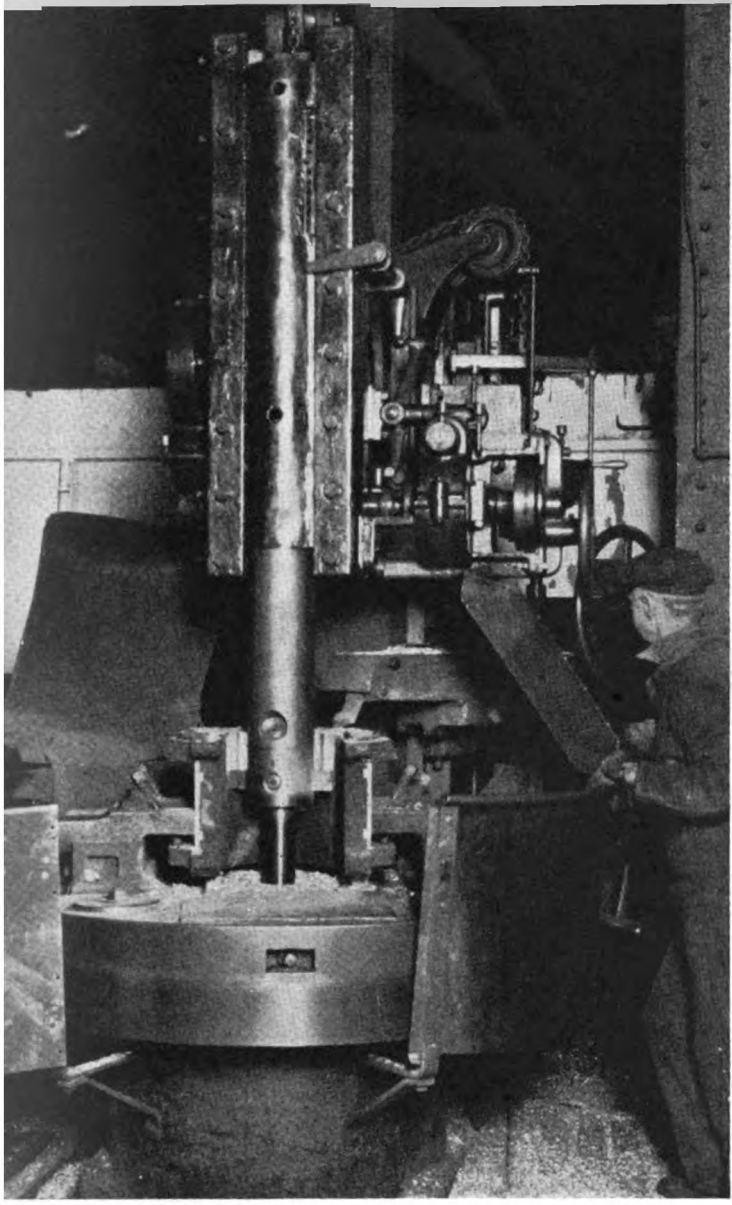


Fig. 7—The table width and fixtures of a modern milling machine will accommodate as many as eight side rods at one time



Eight difficult jobs of

BORING AND TURNING

THE machine operations required on locomotive parts normally performed on a vertical turret lathe or vertical boring mill cover a range of parts from small rod bushings to the largest driving-wheel centers and tires and involve machining time varying from 10 to 15 min. per part up to as much as 10 to 15 hrs. The wide variation in the machining time on many parts finished on machines of these types as performed on some of the older machines which have been in service from ten to thirty years, compared with the minimum time in which it is possible to finish these parts on the most modern machines, serves to emphasize the savings which can be made in many instances on the more modern machines. Some of the typical machine-shop operations performed almost every day have been selected as a basis of presenting time studies. Such jobs as trailer-wheel centers, driving-wheel centers, driving-wheel tires, driving boxes, crossheads, eccentric cranks, cylinder heads and floating bushings are excellent examples. An average shop in the course of a year finds it necessary to machine as many as 100 driving and trailer-wheel centers, from 1,500 to 2,000 driving boxes, 100 crossheads, 200 eccentric cranks, 100 cylinder heads, and as many as 1,000 to 1,500 rod brasses.

Time studies on eight typical machine-shop jobs are presented in this article, together with drawings showing the operations, set-ups and tooling arrangements on many of these jobs. The data on the eight types mentioned are separated into two groups. The first group, dealing with trailer-wheel centers, tires and driving boxes, shows the time in which these jobs can be performed on a modern Sellers boring mill, and the second group shows the time and set-up involved in performing four typical jobs on a Bullard vertical turret lathe with special tooling equipment.

Group 1

Wheels and Boxes

The work involved in finishing a 44-in. trailer-wheel center on an old machine requires from three to six hours in many shops. It is possible on a modern machine to finish one of these wheel centers in two settings of the work in less than two hours. The first operation after setting up the work consists of rough turning the circumference of the wheel center and rough facing the hub. Two cuts at a table speed of 6 r.p.m. with ⅛ in. feed are used on this operation. The next step is to rough bore and then to finish bore the wheel hub for the axle fit. The last operation on the first setting involves the finishing cut on the circumference of the wheel and the finishing of the hub of the wheel. The time required for the first setting is approximately 1 hr. 30 min. The wheel center is then turned over for the second setting and the roughing and finishing cuts taken on the opposite side of the wheel hub. The time required for the work on the second setting, including setting up, machining and removing work from the table, is approximately 25 min., making a total time for the complete operation of 1 hr. 55 min.

A 56-in. cast steel driving-wheel center can be machined on a modern machine in less than six hours. This is also a job requiring two settings. At the first

setting the first operation is to rough-turn the circumference and one side of the rim and hub, taking two roughing cuts over each of these surfaces. On this operation table speeds of 4½ and 12 r.p.m. are used for the ⅛-in. feed. The next operation is to rough bore the hub for the axle fit. The bore on the particular wheel center in question is 12 in. in diameter by 9 in. long. Two cuts are taken through the bore for the roughing operation at a table speed of 16 r.p.m., using 1/16-in. feed. The next step is to finish the bore taking two finishing cuts at a table speed of 9 r.p.m. and ⅛-in. feed. The final operation at the first setting is to take two finishing cuts over the circumference of the wheel at a table speed of 2 r.p.m. and to finish the side of the rim and the hub of the wheel. A ¼-in. feed is used on this operation and a table speed of 6 r.p.m. is used when finishing the hub. The wheel center is then turned over and clamped on the table and the opposite side of the rim and hub is rough turned and faced and a final finishing cut taken. Table speeds of 4½ and 7 r.p.m., respectively, and ¼-in. feed are used. The final operation is to rough face and turn the counterbore and to finish the counterbore. The total machining time, including setting up the work, setting the tools, the actual machining, and removing the work from the table, is 5 hr. 50 min.

In finishing a 70-in. cast-steel driving-wheel center the operations are similar, although involving larger surfaces, and the work can be completed on a modern machine in a total of 6 hr. 30 min.

Another job of this type of machine is the boring, for example, of 70-in. driving-wheel tires, in which the tires are set up in the chuck, rough bored, using two heads, and finally finished bored and the square shoulder cut in the tire. This job can be performed on a modern machine, including setting-up and removing the work, setting tools and machining, in 54 min.

Boring and Facing Driving Boxes

This is a job performed in the average shop every day, and the volume of work is usually sufficient to warrant the installation of a special machine with fixtures and tools especially adapted for the boring of crown brasses and the facing of hub liners. Depending upon the size of the driving box, the average time required on the older machines will vary from 35 to 60 min., whereas on a modern machine with the proper fixtures and tooling equipment this work can be performed in from 15 to 30 min., depending upon the box size. As an example, 11-in. by 14-in. boxes can be bored and faced in an average of 21 min., floor to floor; 13-in. by 14-in. boxes, in 26 min., floor to floor, and 11-in. by 20-in. main boxes with bronze liners, in an average of 30½ min., floor to floor.

Group 2

Finishing Floating Rod Bushings

Figs. 1 and 2 show the arrangement of tools and the manner of performing the several operations involved in finishing a bronze inner floating rod bushing on a 36-in. vertical turret lathe equipped with a three-jaw combination chuck and special tooling equipment. The

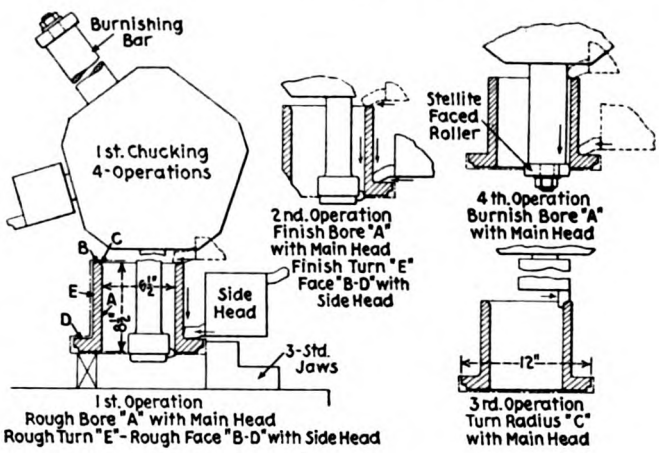
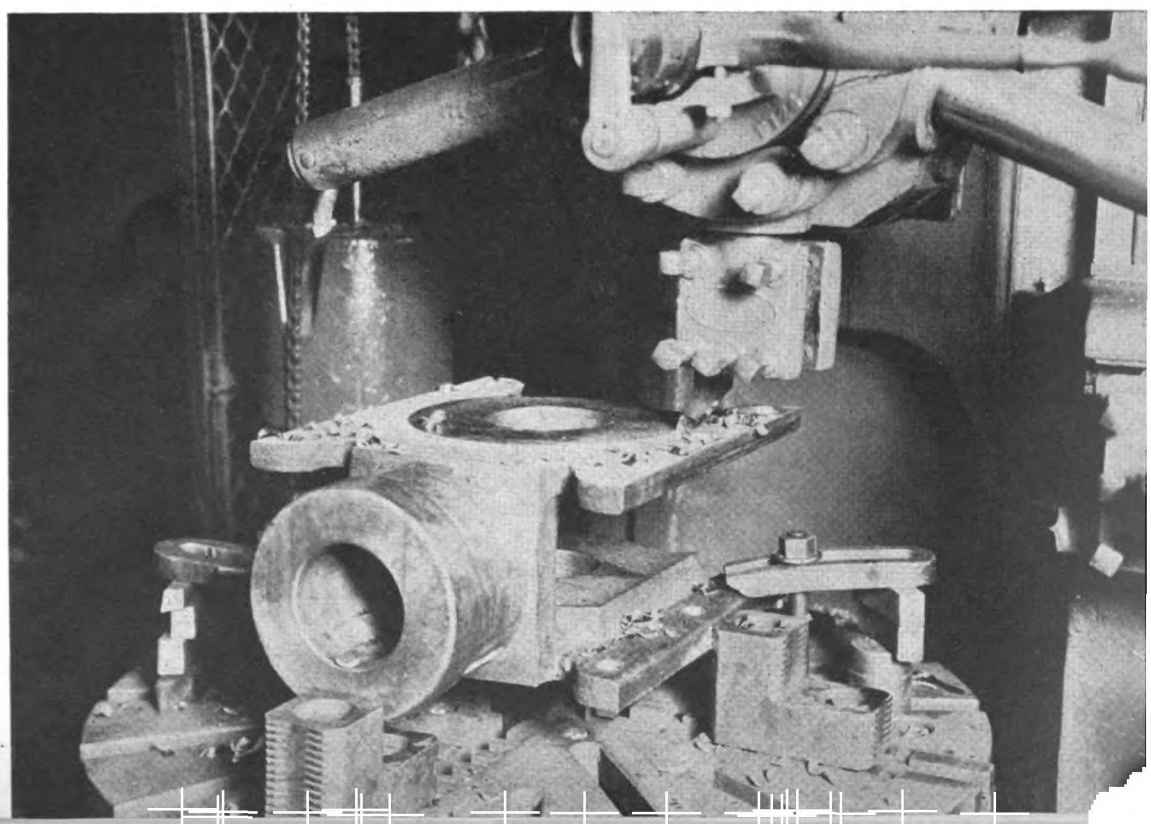


Fig. 1



Finishing a crosshead is one of the most difficult machine shop jobs

entire machining job is performed in two chuckings at cutting speeds varying from 80 ft. per min. on roughing cuts to 190 ft. per min. on finishing cuts. After setting up the bushings in the chuck the first operation is to take a roughing cut down through the bushing on surface *A* with the main head. While this is being done the

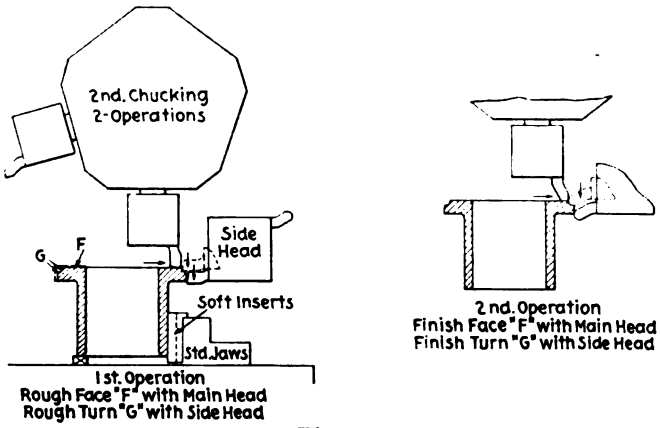


Fig. 2

side head is facing off surface *B*, followed by the turning of surface *E* and the facing of surface *D*. Roughing cutters are then removed and replaced with the finishing cutters preparatory to the second operation which involves the finishing cut on the surfaces above mentioned.

On the third operation the radius *C* on the inside of the bushing is finished. After this is completed the fourth operation consists of burnishing the bore of the bushing (surface *A*) with a tool in the main head equipped with a Stellite-faced roller.

The four operations performed at the first chucking consumed 10 min. of elapsed time, which includes setting up the bushing in the chuck, changing cutters, indexing the side head and turret and removing the work from the table. After this has been done, the second chucking is set up and the first operation consists of a roughing cut to face off surface *F* at the same time that the radius *G* is turned. The second operation consists of the finishing cuts with the main and side heads simultaneously on surfaces *F* and *G*.

The total elapsed time involved in the second chucking from floor to floor is 5 min. The total time for completely finishing this bushing is 15 min.

Machining Eccentric Cranks

This job is performed on a direct-drive high-bed 54-in. vertical turret lathe equipped with four-jaw independent chuck and cutting lubricant system. The eccentric crank finished is a steel forging and before the crank comes to the vertical turret lathe for the finishing operations described here the surface marked *X* has been finished and the slot *Y* milled and wedged and dummy bolts and nuts are inserted and drawn up in place.

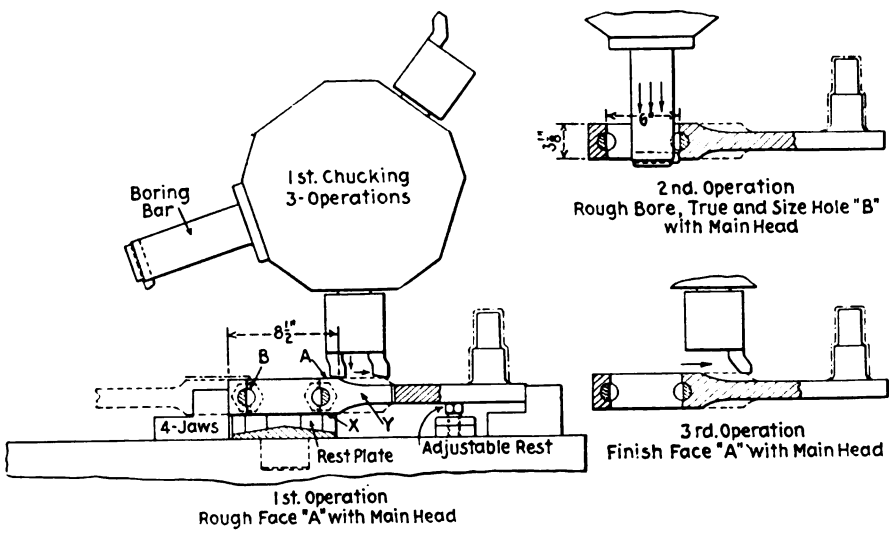
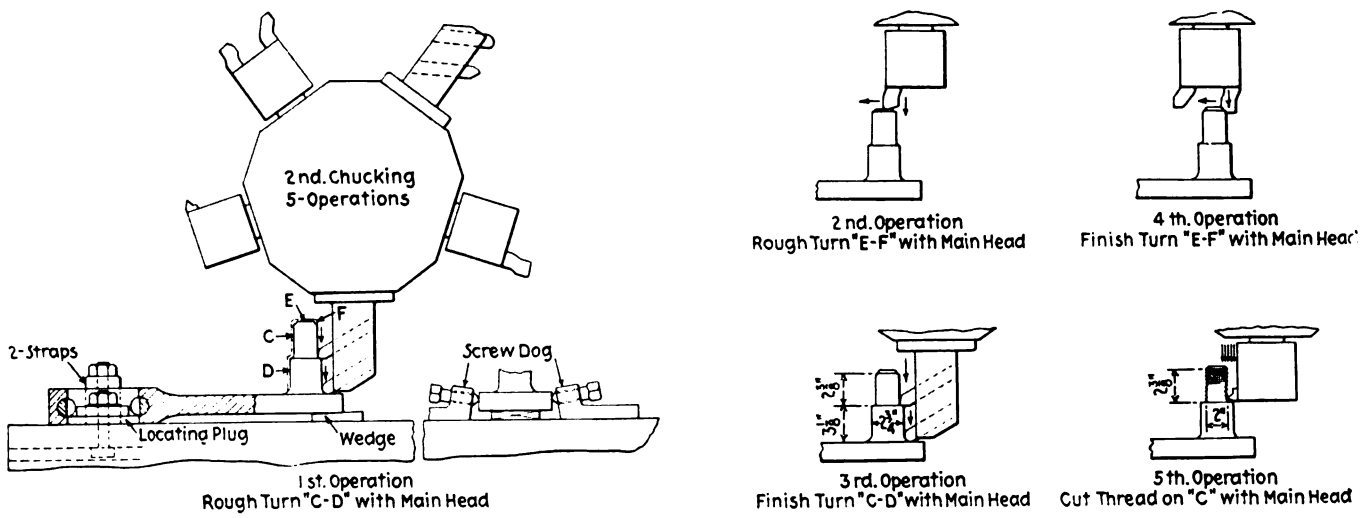


Fig. 3 is shown at the left and Fig. 4 below



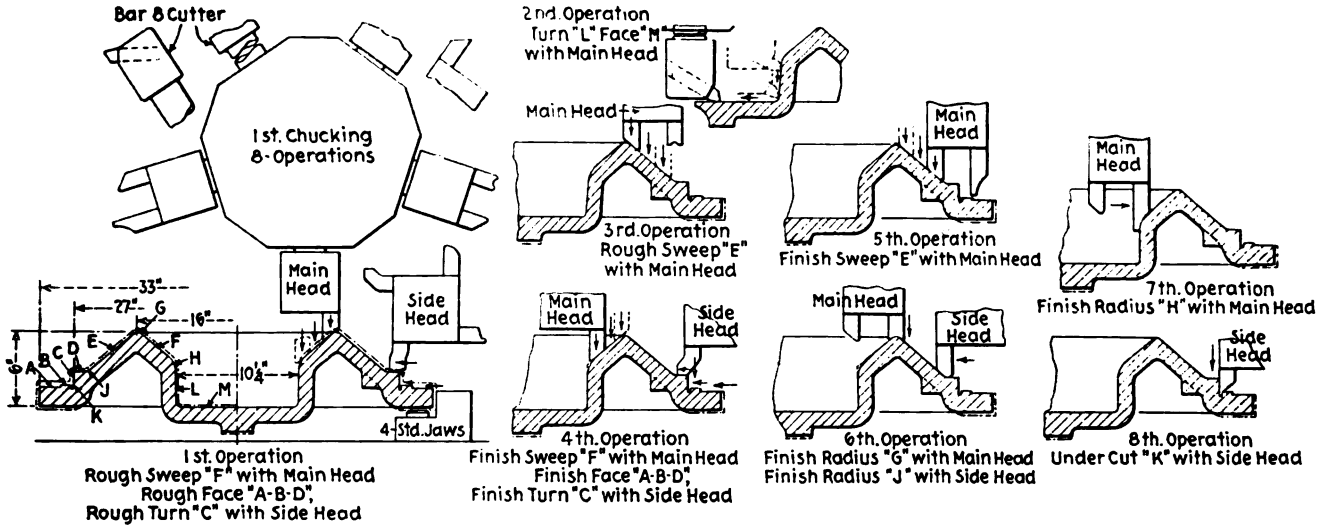


Fig. 5

The cutting speeds used vary from 32 to 73 ft. per min. on the roughing operations and from 31 to 93 ft. per min. on the finishing operations. The complete machining of this crank was performed in two chuckings,

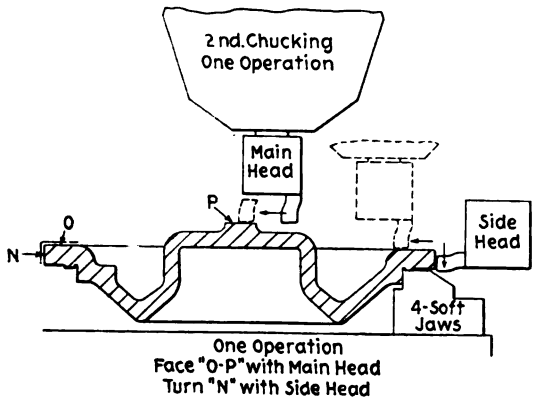


Fig. 6

the first consisting of three operations and the second of five operations, in a total floor-to-floor time of 34 min.

On the first chucking the work is set up in the four-jaw chuck and the first operation consists of a roughing cut over surface *A*. This is shown in Fig. 3. The second operation consists of a roughing cut to bore the hole for the crank pin (surface *B*). This bore is then trued and finished with successive cuts. The third operation on the first chucking consists of finishing the surface *A* with a tool in the main head. The total time from start to finish of the three operations involved in the first chucking is 18 min.

The eccentric crank is then reset for the second chucking by locating on the table with the eccentric-crank pin at the center line of the table, and the work is located over a plug at the outer circumference of the table. This is shown at the lower left-hand corner of Fig. 4. The other end of the eccentric crank at the center of the table is held in place by two screw dogs.

The first operation of the second chucking consists of roughing simultaneously the surfaces *C* and *D* of the pin with the main head, and the second operation consists of a roughing cut on surfaces *E* and *F*. The third and fourth operations consist, respectively, of the finishing cuts on surfaces *C*, *D*, *E* and *F*. The fifth and final operation of the second chucking is the threading of the pin for the eccentric crank nut, which involves eight passes of the threading tool over the length of the threads.

The time involved in the second chucking, including setting-up and removing work, is 16 min., making a total for the complete finishing of this style eccentric crank of 34 min., floor to floor.

Machining a Cylinder Head

It is possible to finish completely a 33-in. O.D. cast-iron cylinder head on a 54-in. vertical turret lathe equipped with a four-jaw independent chuck in a floor-to-floor time of 1 hr. 25 min. The cutting speeds used in the several operations described here in detail vary from 31 ft. per min. on a roughing cut to 77 ft. per min. on certain finishing cuts. The entire job can be performed in two chuckings, the first of which consists of eight operations, and the second of one operation. Fig. 5 shows the various tooling arrangements for the eight operations involved in the first chucking, and Fig. 6 shows the same set-up for the second chucking. The first operation of the first chucking consists of rough turning of surfaces *A*, *B*, *C* and *D*, using the side head of the machine, while at the same time a roughing cut is taken over surfaces *F* with the main head. The second operation consists of the boring of surface *L* and the facing of surface *M*. On the third operation the outer angle of the head is rough turned. The fourth and fifth operations consist of the finishing of surfaces *A*, *B*, *C*, *D*, *E* and *F*, with the main and side heads of the machine working simultaneously. On the sixth operation surface *G* is finished with the main head at the same time that the surface *J* is finished with the side head. On the seventh operation surface *H* is finished with one of the tools on the main head. The turret is then indexed back to the position of the first operation and the eighth operation consists of cutting groove *K* with a tool in the side head. The time for setting up, indexing and performing all of the eight operations of the first chucking is 1 hr.

On the second chucking the work is set up in four soft jaws gripping the cylinder head on the finished surface *C*, and the outer diameter *N* is rough turned with the side-head tool at the same time that a roughing cut is taken over the surface *O* with the tool in the main head. The last step in the second chucking is to rough face the boss *P* on the outside of the head. The time

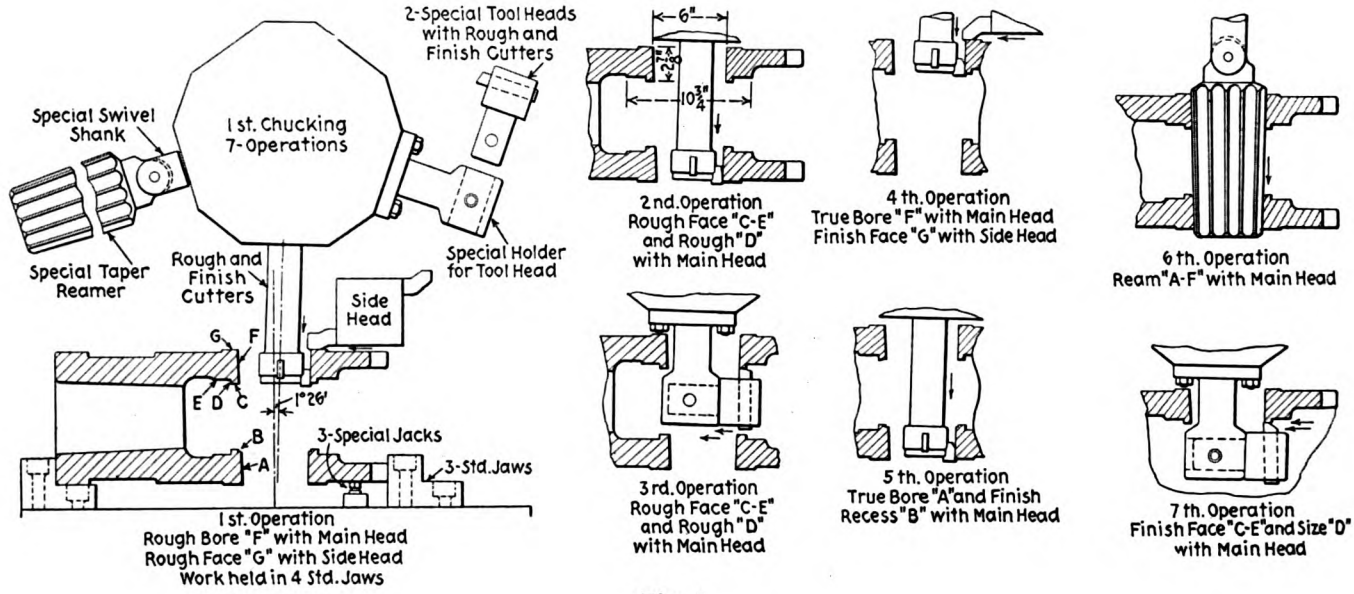


Fig 7

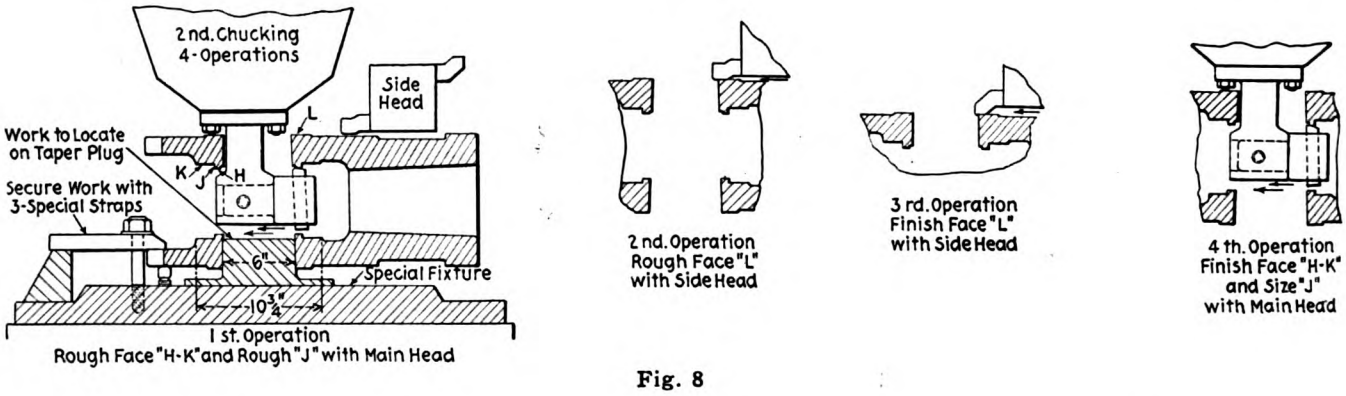


Fig. 8

required for setting up, performing the work and removing the cylinder head from the table on the second chucking is 25 min., making a total time for the complete finishing of the head 1 hr. 25 min.

Finishing an Alligator Type Crosshead

This is one of the difficult locomotive machine-shop jobs which requires, on many of the older machines performing one operation at a time, from four to ten hours to do the same work that can be done on a 42-in. vertical turret lathe equipped with a four-jaw independent chuck in 1 hr. 30 min., floor to floor. The crosshead in question is a steel casting and the cutting speeds vary from 23 to 57 ft. per min. The complete finishing of the crosshead is performed in three separate

(*Continued on page 198*)

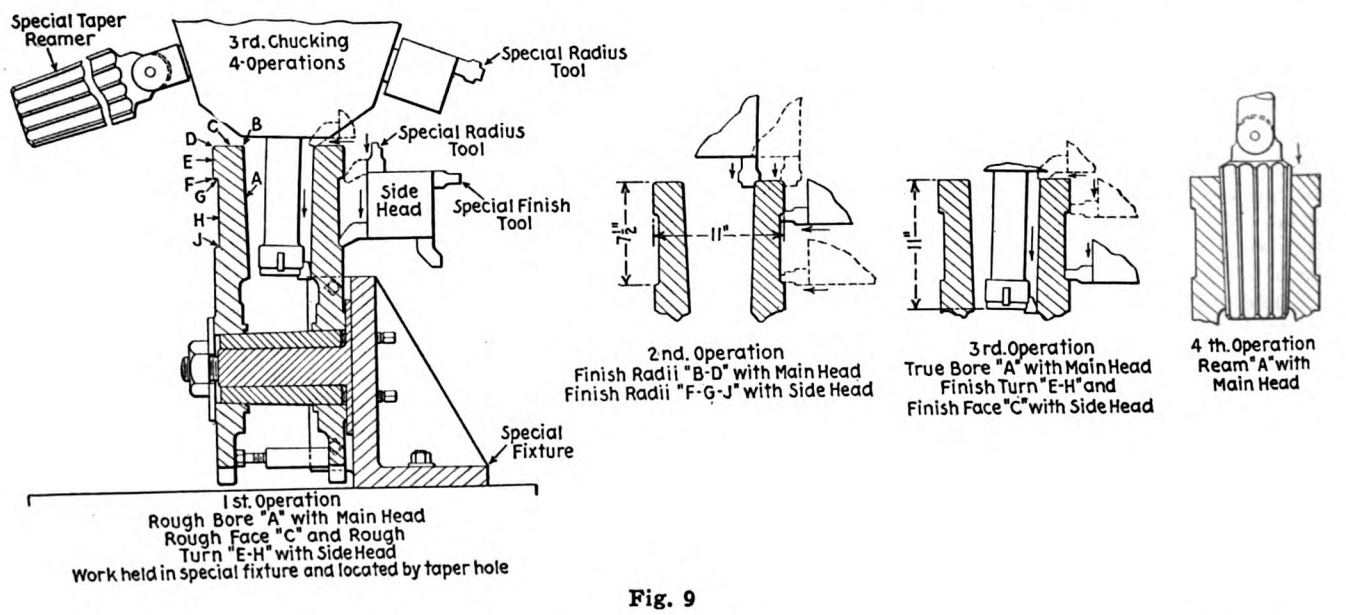


Fig. 9

Machine Tools And Shop Equipment

A chief executive emphasizes the need for better facilities and points out their value as shop operations increase

MANY railroads under normal conditions regularly budget each year a considerable amount of new machine-tool and shop equipment to replace older and obsolete facilities. Unfortunately, conditions have been such during the past few years that, except in a few instances, the railroads have had to keep almost entirely out of the market for such equipment. This is not surprising, particularly in view of the fact that the locomotive and car repair shops have been running with light forces and on short time, if indeed, they have not been shut down entirely for extended periods.

Will the Railroads Buy New Tools?

Will the railroads go into the market for new equipment of this kind in the near future? This question was propounded to the chief executive of a railroad which has maintained its shop and enginehouse equipment well above the average.

"It is purely a matter of finance," said the Chief Executive. "Our shops are being worked well below capacity and this will continue until there is reasonable assurance of a much larger traffic than we are now handling. There is no question but that we can improve the efficiency of shop operations by replacing some of the older machine tools and shop equipment. On the other hand, there are more pressing demands upon us for other kinds of expenditure. State regulation also, for instance, is forcing us to spend considerable money for grade crossing elimination, on which, incidentally, we will receive little if any financial return."

"Would it be advisable for you to purchase new tools and shop equipment at the present time, if you could obtain the money on reasonable terms, such, for instance, as extended by the government for the purchase of new cars and locomotives?"

Sees Improved Business In 1935

"Yes," replied the Chief Executive. "In my opinion business in 1935 will be such that we will be forced to operate our shops and enginehouses on a more normal basis, and new tools and equipment installed prior to that time will give a good account of themselves."

"If this is true," I suggested, "ought not steps to be taken promptly to insure the purchase of machine tools and shop equipment during the present year?"

"Yes," responded the Chief Executive. "If we could obtain money from the government for such purposes on reasonable terms, it would take so much time to consummate the financial arrangements; decide upon just what tools and equipment were most needed in the shops and enginehouses; secure bids; allot the orders; build, deliver and install the tools and equipment, that they would hardly be available for use much before the end of the present calendar year—possibly not far in advance of the time when they will really be very much needed.

Old Tools Should Be Replaced

"Is there much machine tool and shop equipment which can be replaced to advantage at this time?"

"Yes," said the Chief Executive. "In our own shops, which, as you know, have been kept reasonably up-to-date, we are suffering because of the lack of expenditure for machine tools and shop equipment during the past few years. There are several reasons for this. Our road, like many others, has been closing some of the smaller shop and repair points and has been attempting to concentrate repairs at a central point. You can readily understand that an increased amount of work of any one kind at a given shop may be sufficient to warrant the introduction of special machinery, which can be operated more on a production basis. Under such conditions one new special tool may replace several of the older tools, thus economizing in shop room and making it possible to arrange the machinery in such a way as to facilitate operations and cut down unit costs."

Expensive Tools Lie Idle

"The argument has been advanced," I said, "that new machine tools, specially adapted to the work, may have to lie idle a considerable part of the time. Can this be justified?"

"In many instances, yes," replied the Chief Executive. "It is conceivable that a special tool might be so expensive that the interest on the investment and depreciation would increase unit costs to an unreasonable point, and that under such conditions the use of the new machine tool could not be justified. On the other hand, most of the machine tools used in railroad shops do not come within this category and the increased cost of investment will not offset the savings in labor which may be made by the increased rate of production. Even if, because of idleness, the unit costs remain as great as they were before, the use of some of these machines may make it possible to cut down the amount of time that the locomotives and cars are held out of service. In addition to this they afford a reserve capacity that can be utilized to excellent advantage under peak-load conditions."

"This suggests, does it not," I said, "that each case must be considered by itself and on a scientific basis?"

"Quite true," said the Chief Executive, "and if I understand conditions correctly, the tendency has been more and more in that direction in recent years. The fact must not be lost sight of, also, that the engineering forces of the machine tool builders are in excellent position to assist in making studies of this sort."

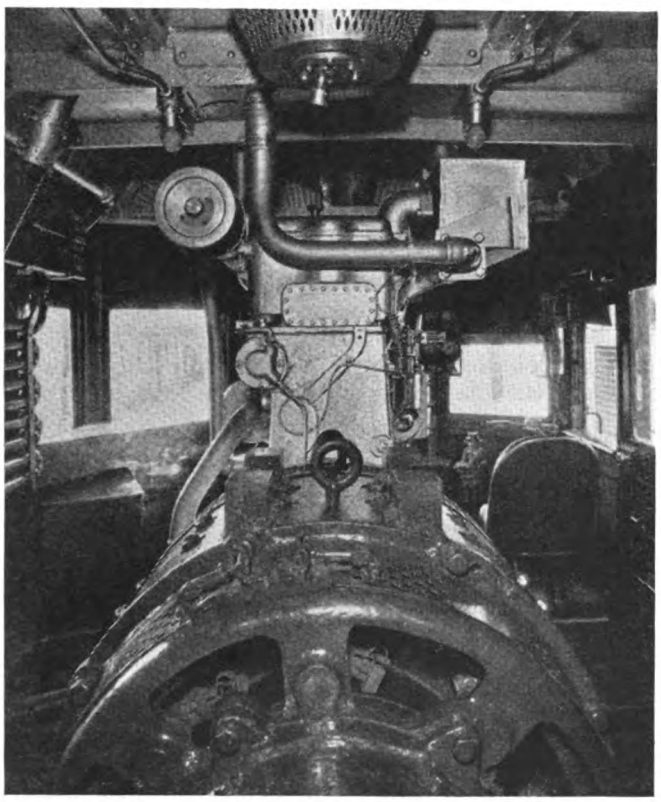
Gas Rail Car Converted to Diesel Type

By T. H. Murphy*

Seaboard Air Line car shows fuel saving at the rate of $10,000 a year after installation of Diesel engine power plant

THE Seaboard Air Line recently replaced the gasoline engines in a rail car purchased in 1928 by a modern Diesel engine. Studies of the relative economies indicate savings sufficient to justify the use of this prime mover. One Diesel engine-generator set was purchased and installed in 1933 and operating data after 10,000 miles of service show that savings the first year on fuel alone will total over $10,000 and be well above preliminary estimates.

The Seaboard Air Line car No. 2013, operating between Savannah and Americus, Ga., was selected for the changeover. This car was purchased in 1928 and had operated over 600,000 miles in revenue service with satisfactory performance. The car body is divided into a 44-ft. 10-in. baggage compartment, a 15-ft. standard railway post office, and a 13-ft. 2-in. engine room. The car



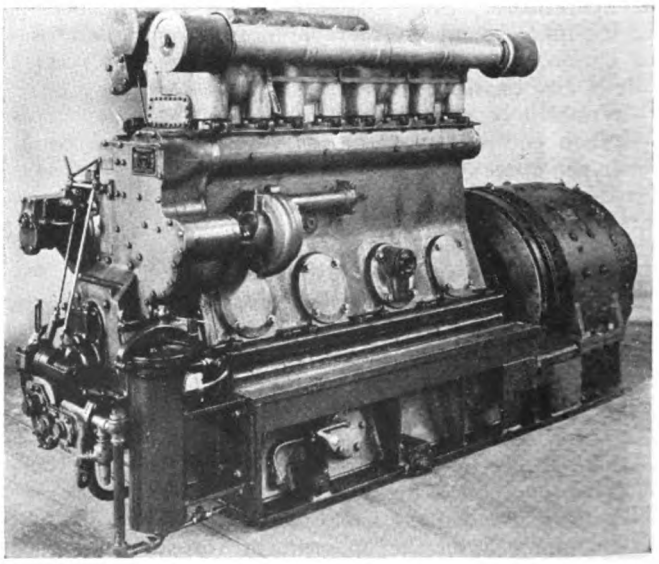
Engine room with Diesel power plant

was equipped with a gasoline engine of the six-cylinder type with 7½-in. bore and 9-in. stroke, and rated at 1,050 r.p.m. A direct connected generator supplied power to two traction motors and a small generator mounted on the shaft of the main machine furnished auxiliary power.

Conversion Apparatus

The gas-engine-generator set was replaced by a Westinghouse Diesel power plant rating 265 hp. at 900 r.p.m. The new unit fitted into the engine room without modification to obtain greater space at any point and the accessibility of parts is equal to that had before the conversion. The engine is a four-cylinder, four-cycle, solid-injection, light-weight Diesel type manufactured by the Westinghouse Electric and Manufacturing Company for both rail cars and locomotives. It has an oil governor and automatic timing that permit variable engine-speed control. Individual aluminum alloy cylinder heads with dual valves and renewable valve seats, aluminum pistons, and removable liners are features of the engine. Covers enclose completely the valve gear which is fully pressure lubricated. A low lubricating-oil-pressure trip and a protective overspeed flyball governor provide operating safety. The crankshaft is a solid forging with integral counterbalance weights and drives a dynamic balancer mounted in the crankcase. Torsional vibrations are absorbed by a damper mounted at the front of the engine.

The existing radiator cooling system was retained but this was supplemented by a lubricating-oil radiator mounted at the front of the car to obtain natural-draft



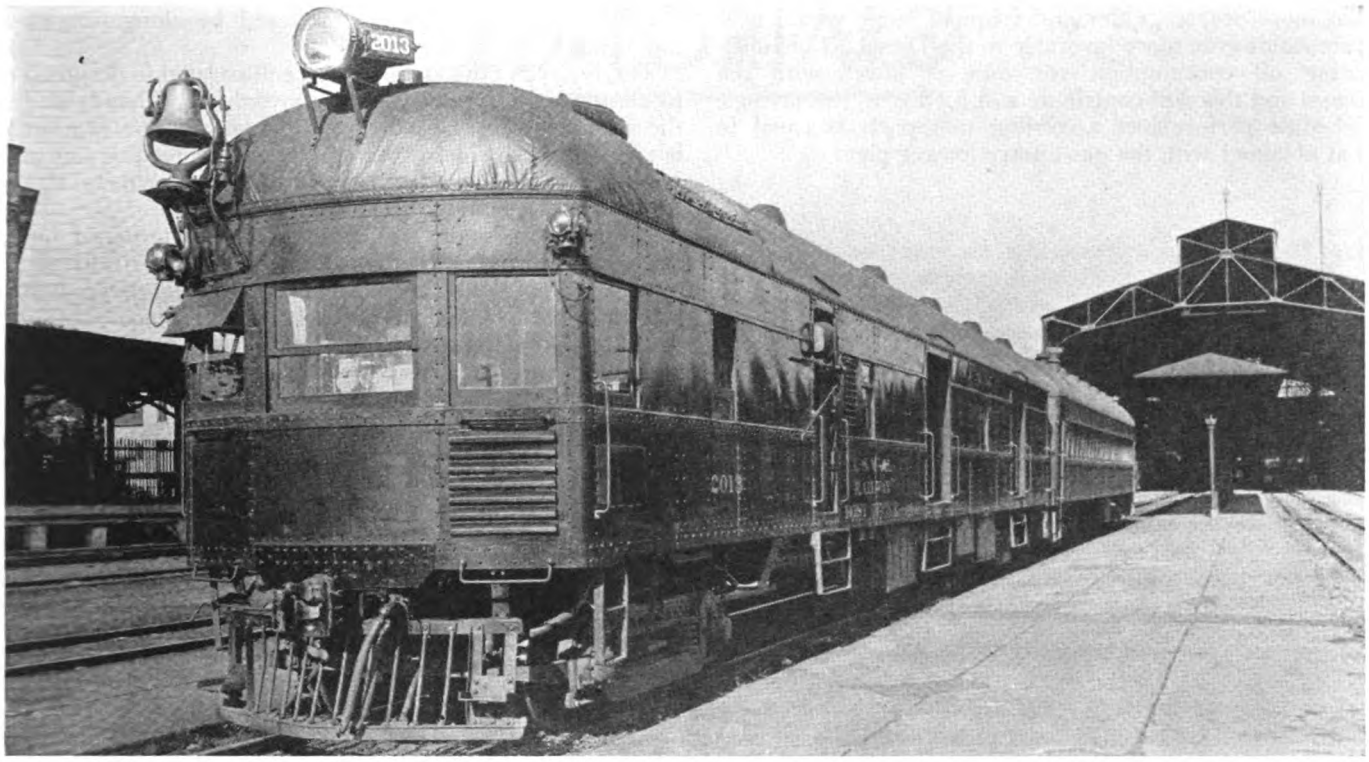
Diesel power plant used on car

ventilation. The fuel tanks were not changed but a gear-type motor-driven pump was mounted at the tanks to replace the vacuum system used with the gasoline. The fuel consumption was reduced over 50 per cent by the Diesel installation so that the cruising range of the car without refueling has been doubled.

Control

Very few modifications were made to the control. Electric engine starting by means of the generator and

* Railway Engineer, Westinghouse Elec. & Mfg. Company.



Seaboard Air Line rail motor car No. 2013 converted to Diesel type

battery, the controller for motor connections, a mechanical throttle, and a differential generator characteristic with variable engine-speed control were retained. New propulsion and auxiliary generators were necessary because of the difference in engine rated speeds and mounting requirements, but the differential characteristic is essentially the same except for an improvement that gives better engine power utilization.

The existing 32-volt, 16-cell battery was supplemented by 16 additional cells to provide a higher firing speed that is necessary with the Diesel engine. However, the feature of 32-volt control and lighting was retainel by

Table I—Service Data

Operation	Time Table Information Round trip daily between Savannah and Americus, Ga.	
Seaboard Airline train Nos.	13	14
Schedule time	6 hrs. 55 min.	7 hrs. 05 min.
Revenue miles	198.6	198.6
Schedule speed, m.p.h.	28.7	28.1
Non-revenue miles	2.75	2.75
	Comparative Data	
Type of Equipment	Diesel	Gas
Daily miles	402.7	402.7
Miles of comparative record	10,000	634,000
Gallons of fuel per day	139.5	288
Train miles per gallon	2.89	1.4
Fuel cost per gallon, cents	4.0	12.52
Fuel cost per train mile, cents	1.384	8.96
Annual miles (90 per cent Availability)	132,200	132,200
Annual fuel cost	$1,829.65	$11,845.12
Annual fuel saving	$10,015.47	
Miles per gallon of lubricating oil	94.5	92
Train weight, tons	101.45	93.0
Ton miles per gallon	293	130

automatic parallel connection of the two 16-cell battery sets for running and the provision of a series connection to give 64 volts for engine starting.

The auxiliary generator has been the sole source of power for both the motor and trailer batteries. Its voltage was sufficient for charging only when the engine was almost up to rated speed. A fairly high charging rate was necessary as the available charging time was only a small percentage of the total operating time due to the fact that the engine idled when the car was coasting or standing in stations. The Diesel engine is governed at a constant speed when idling and the propulsion generator maintains voltage of the proper magnitude for charging the battery. This permitted modifying the control so that, in addition to the charging from the auxiliary generator, the main generator charges the battery when the engine is idling. It is expected that this feature will give longer battery life due to the more uniform charging rate possible and will eliminate charging at terminals.

Operating Results

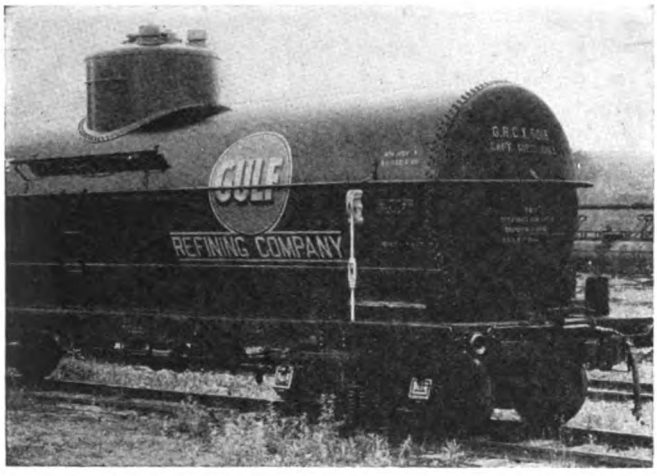
Numerous Diesel-electric rail cars have fuel consumptions in gallons per mile from one-half to one-third of that of gas-electric cars, and ton-miles per gallon two to three times greater. This lower volume consumption is due to the efficiency of the Diesel engine which is obtained by higher compression, and to the greater B.t.u. content of a gallon of fuel oil as compared with a gallon of gasoline. Many Diesel engines have a guaranteed fuel rate as low as 0.43 lb. of oil per brake horsepower per hour, and consumptions as low as 0.40 lb. are obtained. A gasoline engine will consume usually not less than 0.60 lb. per brake horsepower per hour at full load, and in actual average service is much higher generally because of a rapid decrease in efficiency at less than full rated load. The average weight per gallon of gasoline is only 6 lb. as compared with 7.5 lb. average for fuel oil. These figures indicate a volume consumption for the Diesel of 0.0575 gallons per brake horsepower per hour, and for the gasoline engine 0.10 gallons or about twice as much. Preliminary studies on the Seaboard were based on a 1 to 2 ratio.

The conversion has given an actual comparison in identical service. The fuel consumption ratio is less than 1 to 2 for the first 10,000 miles of Diesel operation compared to the previous gasoline performance and 2.26 to 1 is the ratio of ton-miles per gallon. It is expected

that more severe grades and frequent stops would produce ratios even more favorable to the Diesel. The lubricating oil consumption per mile is lower with the Diesel and this will contribute still further to the savings. Schedule performance according to reports is equal to that obtained with the gas-electric power plant.

Tank-Car Stabilizer

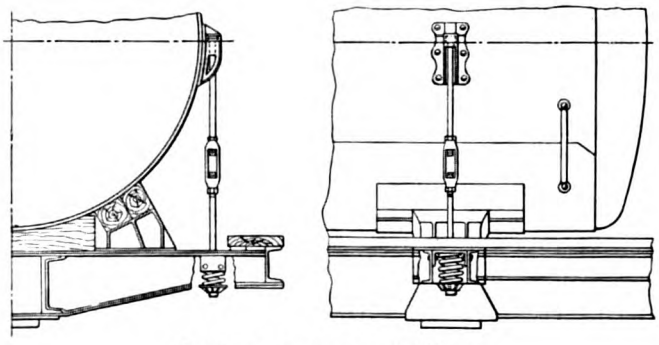
AN improved method of securing the tanks of tank cars to the underframes has been developed by J. C. Sullivan, general superintendent, Gulf Refining Company, Pittsburgh, Pa. The object of the device is to eliminate the tank bands which have been heretofore used for this purpose. That the common tank bands have not been entirely satisfactory is quite generally



Tank car equipped with stabilizer

recognized—due to their tendency to loosen, causing the center anchorage rivets to shear, leakage at tank riveted seams, or bucking of the tank bottom plates.

On many tank cars the bands have been provided with turnbuckles as a convenient means of tightening them,



Sullivan tank car stabilizer

but in practice it has been found that bands do not stay tight. No provision having been made to compensate for variations in tank diameter due to expansion, a resulting high pressure is exerted against or near the top horizontal seam and leakage at the seam has resulted until the excess pressure becomes relieved by elongation of the bands.

The Sullivan tank stabilizer here illustrated is designed to eliminate leakage caused by too tight tank bands and the shifting of loose bands. As will be noted, a bracket is riveted to the side of the tank at the center line and a 1⅜-in. bolt provided with a turnbuckle connects this bracket to the body bolster of the underframe.

At the lower end a resilient spring is interposed between the spring seat attached to the bolster and the spring cap on the bottom end of the holding-down bolt or stay rod. The helical spring has a capacity of 44,000 lb., the desired tightness and spring compression being obtained by adjustment of the turnbuckle. The stabilizer thus provides a resilient means for holding down the tank, and by eliminating the faults of present designs reduces the cost of tank maintenance.

The first tank stabilizer was applied in December, 1930, and over 60 Gulf Refining Company tank cars have since been equipped. Up to date no repairs have been required either to the stabilizers or to the tanks of cars so equipped. The A.R.A. Committee on Tank Cars has recently given approval for the equipping of 135 additional cars with the usual proviso that annual reports indicating service performed be submitted.

Eight Difficult Jobs of Boring and Turning

(*Continued from page 194*)

chuckings. The first chucking consists of seven operations (shown in Fig. 7) as follows:

1—Rough boring surface *F* with main head while side head is rough facing surface *G*.
2—Rough boring surface *A*.
3—Rough turning surfaces *C*, *D* and *E*.
4—True up bore *F* with main head and finish surface *G* with side head.
5—True up bore *A* and recess surface *B*.
6—Ream bores *A* and *F*.
7—Finish surfaces *C*, *D* and *E*.

The time required for the above seven operations, including removing the work, is 35 min.

The second chucking consists of four operations (shown in Fig. 8) as follows:

1—Roughing cut surfaces *H*, *J* and *K*.
2—Rough facing surface *L*.
3—Finish cut surface *L*.
4—Finish surfaces *H*, *J* and *K*.

The time for the above four operations, including removing the work, is 22 min.

Fig. 9 shows the third chucking in which the crosshead is mounted on a special fixture and located by a tapered plug in the wrist-pin hole. The third chucking, consisting of four operations, is as follows:

1—Rough surface *A* with the main head simultaneously with the roughing of surfaces *C*, *E*, and *H* with the side head.
2—Finish radii *B*, *D*, *F*, *G* and *J* with the main and side heads.
3—True up the tapered bore *A* with the main head and finish surfaces *C*, *E* and *H* with the side head.
4—Ream the tapered bore *A*.

The time required for the four operations involved in the third chucking, including removing the work, is 33 min. The total time for finishing the crosshead completely is 1 hr. 30 min. The time given for the several operations in the complete finishing of the crosshead is based upon the assumption that not more than 3/16 in. material is to be removed from any machined surface.

EDITORIALS

Paying for Something You Don't Get

When a railroad company contemplates the purchase of a new machine tool or piece of shop equipment, it is fairly common practice to demand a saving of at least 17 per cent on the investment before any consideration will be given the new equipment. The 17 per cent is arrived at, for example, by setting up interest at 6 per cent, insurance and taxes at 1.5 per cent, depreciation at 4.5 per cent (based on 20 years' life with 10 per cent salvage at the end of the period) and repairs at 5 per cent. Of these four items which in this case make up the 17 per cent, two of them—depreciation and repairs—are open to question and discussion.

Without embarking on any long drawn-out discussion of the question of depreciation of shop equipment the fact remains that regardless of what the railroads may consider an adequate depreciation rate they have never, taken as a whole, charged to operating expense an amount even approaching 4.5 per cent of their investment in shop equipment. It is doubtful whether many roads have even given serious thought to the question of shop equipment depreciation other than to set up an arbitrary rate for the purpose of estimating returns on investment in new equipment. For the purpose of discussion, therefore, an arbitrary rate of 4.5 per cent is assumed to be a fair rate at which equipment would be written off in 20 years, with 10 per cent of its original value as salvage at the end of the period.

In considering the question of repairs to shop equipment we are dealing with a factor about which very little accurate information is available, in spite of the fact that apparently this item is of considerable importance. It is accepted, however, that, as with other mechanical equipment, the cost of repairing machine tools and shop equipment increases considerably with age.

Actual Depreciation Low

Estimates made on as accurate a basis as possible place the value of the railroads' investment in machine tools and shop equipment at an average of approximately 350 million dollars during the ten-year period 1920-1929. Upon such a basis the Class I roads have charged off an average of 1.47 per cent annually in depreciation and have expended an average of 7.15 per cent annually for repairs. The experience of some few roads that have kept records of shop-equipment repair costs indicate that seven per cent represents a fair figure for the average well-managed railroad shop.

It has been stated that the railroads generally do not establish a machine tool depreciation rate, but if the 1.47 per cent is any indication of what has actually taken place, then it must be assumed that mechanical officers hold a rather liberal view of the life of a machine. Some few of our more up-to-date shops show an average age of all machine tools of slightly over 20 years which would indicate that the majority of the shops and enginehouses are equipped with tools considerably older than 20 years.

The statement is frequently made that the reason why railroad shops are equipped with so many old machines is that the machines are still serviceable in spite of their age and that the savings possible on a new machine will not justify the replacement of the obsolete machine. Whether or not a machine can profitably be replaced depends to a large extent upon its age, for with advancing age its productivity as compared with a new machine steadily decreases, while at the same time the cost of maintaining it in service steadily increases. In highly specialized industrial plants many machines five to ten years old are obsolete because of radical changes in processes and were the original value of such machines not charged off before obsolescence, of one kind or another, forces their retirement the undepreciated investment remaining on the books represents a direct loss.

One large manufacturing plant using machine tool equipment similar to locomotive repair shops has for several years followed a policy of depreciating machinery at an annual rate of 10 per cent and using the reserve set-up to purchase new machinery each year. The result is that this plant has no machine tools over 12 years of age at the present time. The most significant fact about this plant is that its average annual expenditure for machine-tool repairs is slightly less than 1.5 per cent of its investment. Compare this with the 7 per cent in the railroad shop where the average machine tool age is over 20 years.

Assuming that railroad shop management had been foresighted enough to establish even a 15-year service life for its machine-tool equipment and that a repair budget as high as 4 per cent were used for the 10- to 15-year old machines, then the average annual repair rate would be 2.3 per cent on the original investment and the annual depreciation rate (for complete write-off) would be 6.6 per cent. On such a basis the railroads would then need to demand a saving of only 16.4 per cent on the investment to justify new equipment.

If all machine tools in the railroad shops were 15 years old or less, and could be repaired for 2.3 per cent annually, as seems to be the case in some modern industrial plants, then the railroads would spend for the maintenance of shop machinery alone some 15 million dollars annually less than they spent on the average during the years 1920 to 1929, inclusive.

Obsolete Tools a Direct Loss

While it is difficult to obtain figures which will substantiate the fact, there is every reason to believe that if accurate cost records of shop equipment repairs were maintained, it would disclose that the railroads are paying heavily for a short-sighted policy of maintaining in service obsolete machine tools and that, if a general policy were adopted of replacing machine tools on a basis of 15 years' service life, their out-of-pocket expenditures would be no greater than is now the case. The acceptance of an inadequate depreciation rate merely tends to continue machine tools and shop equipment in service long after they have reached the end of their economic service life, and the railroads are the direct losers to the extent of an amount equal to the saving that could be made in machine-tool repairs, plus the direct savings in labor which are possible as a result of the greater productive capacity of tools of modern design.

When it is considered that in the 10-year period from

1920 to 1929, inclusive, over 251 million dollars were spent by the Class I railroads for repairs to shop equipment and machinery and that less than 4 per cent of all the money spent for improving railroad facilities during that period was spent for shops and enginehouses, which facilities are used for the maintenance of equipment involving over one billion dollars in 1930, it would seem that the time is at hand when the question of maintenance facilities should be given the attention which its importance warrants.

A thorough study of that phase of railroad operation relating to maintenance of equipment would undoubtedly indicate that the railroads are actually paying out money on maintenance facilities which results in keeping many obsolete units of equipment in service and deprives them of the benefits which the expenditure of the same amount of money would assure them.

Evidences Of Progress

The past two years or more have been exceedingly difficult for the railroads; indeed, they have had to lead a hand-to-mouth existence and the purchase and installation of new equipment and facilities has been quite impossible. Underneath the surface, however, a lot of hard thinking and planning has been done, the results of which are now becoming partially evident. One clear indication of this may be had by comparing the transportation exhibits at the Century of Progress Exposition this year, with those of a year ago. Moreover, even the casual reader of the newspapers is acquainted with the introduction of the high-speed, streamlined passenger trains and some of the more prosaic advances, such as pick-up and storedoor delivery in the freight traffic department.

Light, High-Speed Passenger Trains

The Union Pacific streamlined train on May 5 ended a two-months exhibition tour, during which it traversed twenty different states and encountered all sorts of climatic and physical conditions. It was visited by well over a million people. No attempt was made to test the train for speed, but it is said to have operated at an average speed well above 70 miles an hour, and in a special test registered 111 miles an hour.

The Chicago, Burlington & Quincy Zephyr has also ended a successful exhibition tour, closing it on May 26 by making the longest high speed passenger-train run on record. The trip of 1,015.4 miles between Denver, Colo., and Chicago was made in 13 hr. 5 min., or at an average speed of 77.5 miles per hour. Both the Union Pacific and the Burlington trains are now on exhibition at the Chicago Exposition.

In addition to the three-car, articulated streamlined train, the Union Pacific, is now constructing three other trains, one composed of six cars, and two others of nine cars each. The first will be driven by a 900-hp. Diesel engine, and the nine-car units will be propelled by 1,200-hp. Diesel engines. Each of these trains will be furnished with specially designed sleeping cars, thus making them available for long over-night runs.

Several other railroads are also indicating an active interest in high speed, streamlined trains. The Baltimore & Ohio, for instance, is building two such trains, one of which will be operated by steam power and the other by an 1,800-hp. Diesel-electric engine, and both of which will be capable of operating at speeds of 90 to 100 miles an hour. A departure has been made from the Union Pacific and Burlington trains, both of which are articulated; the Baltimore & Ohio cars will each be independent units.

A three-car streamlined train has been ordered by the New Haven. It will be operated between Providence and Boston, a distance of 44 miles, in 44 minutes. There are no facilities for turning the train at Providence and it will be necessary to provide for double-end operation. Two power units will be applied, one at each end of the train. The Boston & Maine has ordered 21 suburban passenger coaches to be constructed of light weight alloy steel. These will seat 96 persons and will weigh approximately 84,000 lb. each.

The building of this special passenger equipment seems to have caught the popular imagination, and coupled as it is with the extensive program for air conditioning passenger cars on most of the first-class trains, it has given the impression that the railroads are determined to regain passenger business which has been lost to other types of carriers.

Financing New Equipment

The building of this equipment has been made possible largely by P. W. A. loans to the railroad companies. Money from the same source will also finance the building of considerable other new equipment, as well as the rebuilding and repairing of cars and locomotives, all of which has been helpful in re-vitalizing the railway supply business and getting more men back to work in the railway locomotive and car repair plants.

The new locomotives now under order will include a number of interesting features, and their performance will be watched closely when they are placed in operation. There has been much talk about relegating steam locomotives to the scrap heap; the designers, however, have squarely met this challenge and there is no question but what the new steam locomotives will set a record of performance beyond anything that has yet been accomplished.

Diesel Engines Becoming Popular

Meanwhile, the Diesel and internal-combustion engines have been receiving an unusual amount of attention. This type of power will be used on most of the streamlined, high-speed trains. The Diesel-electric switching locomotives have also been giving a good account of themselves and on the basis of performance several additional units have been ordered by different railroads. This type of power is also being considered for road service.

The Car Construction Committee of the Mechanical Division, A.R.A., two years ago made its recommendations for a standard box car. Samples of these cars have been built and have been thoroughly tested out with excellent results, including a considerable saving in the tare weight of the car. The railroads are beginning to order this new standard car. During the past year, also, the new "AB" type of brake equipment has been adopted as standard and is being placed on all the new freight cars.

Pick-Up and Store Door Delivery

These are only a few evidences of rather radical and distinct improvements which are being made in railway equipment. This progress will undoubtedly be quickened by the fact that the railroads are making a determined effort to build up both freight and passenger business. The pick-up and storedoor delivery of mer-

chandise shipments has been inaugurated in many places and in all probability, as it is extended, will force the consideration of new types of equipment, which will facilitate the handling of these shipments and may, in the last analysis, do away to a large extent with present freight terminal facilities, since ways and means will undoubtedly be found of transferring the shipments directly from the car to the consignee. Co-ordinator Eastman in his report on merchandise shipments, has also suggested that highway and rail services be co-ordinated by establishing concentration stations on the highways, so located that shipments will be gathered at or distributed from these points, the long haul between the concentration stations being done by rail.

Co-ordinator Eastman's Efforts

One of the outstanding features of the year has been the thorough studies of all phases of railroad operation made by Co-ordinator Eastman and his organization. A wealth of material has been assembled, which is being carefully and critically analyzed, and which will be of great assistance in planning to improve the transportation plant and put it on a more efficient and economical basis. In all probability it will demonstrate clearly and beyond question the folly of attempting to operate old, obsolete cars and locomotives. It promises, also, to place squarely before the railroads the question of the advisability of pooling freight car equipment. Mr. Eastman's investigations have even gone into the repair shops, as is shown elsewhere in this issue. Is it good business to attempt to operate old machine tools and shop equipment, or can some of it at least be replaced to advantage by new and modern equipment? These and many other questions will have to be fought out on the basis of facts developed in the studies and researches which are now being made.

Railways Unfairly Dealt With

In light of these facts, it is unfortunate that the Administration at Washington has been so busy that it has neglected to afford much needed relief to the railroads by protecting them from the ruthless competition of other types of common carriers. The rehabilitation of the railroads could be accomplished much more quickly and greater advantage could be taken of the developments which have been referred to, if the other types of carriers that are now subsidized to the disadvantage of the railroads, could at least be subjected to regulation which would place them more nearly on a parity with the railroads. Every impartial group that has made a critical study of this problem agrees that the railroads are being militated against and that something should be done by the government to correct this situation. In spite of all this, and in spite of the promises made by the Administration, the present Congress has been indifferent to the situation.

The railway employees and taxpayers movements in certain parts of the country have been helpful with some of the state legislation, and to some extent have taken an interest in federal legislation, but, unfortunately, not enough pressure has been brought on Washington to force the issue. Apparently, if we are to get anywhere in this respect, every employee of the railroads and every friend of the railroads, must use whatever influence he may have. It is greatly to the interest of the employees to do this, because the success of the other types of carriers in taking business away from the railroads is due in no small degree to the fact that the employees of these carriers are paid lower wages and work under less attractive conditions, than do the employees of the railroads.

Comparing Diesel and Steam Locomotives

The Diesel-electric locomotive has already demonstrated its wide adaptability for switching service, and, judging from experimental development work now well under way, the Diesel prime mover will also soon be a real factor in main-line service. While most railroad men, through long familiarity with the simplicity, reliability and effectiveness of steam locomotives, have a natural preference for this type of power, this preference will in the long run be freely subordinated to the best interests of the railroads in using the type of power which produces the most satisfactory results for the least aggregate cost.

In comparing various types of power for specific transportation requirements, it is self-evident that all factors, such as relative performance, crew wages, cost of fuel, lubricants and water, enginehouse expense, first cost of the equipment, depreciation, maintenance, etc., must be considered before any accurate conclusions can be drawn. Obviously, entirely misleading conceptions may result from comparing the operating cost of a modern Diesel-electric locomotive with that of an old and entirely inadequate steam locomotive, and this point was stressed in the discussion of a paper on Diesel locomotives presented before the April meeting of the Western Railway Club. In this connection, T. R. Cook, manager of inspection and field service, Baldwin Locomotive Works, while specifically advocating the use of that type of power, whether steam, Diesel, or some other kind, which will perform the work required most economically, said:

"I have recently had occasion to compare the operation of an 800-hp. Diesel locomotive with a steam locomotive having the same weight on drivers, namely 230,000 lb. Under this condition, you will find that the horsepower of the steam locomotive passes the horsepower of the oil-electric at 3 m.p.h. With a cut of cars, weighing 500 tons, the oil-electric locomotive will get away ahead of the steam locomotive. The steam locomotive, however, will pass it in less than 20 ft. from the starting point. The steam locomotive will arrive at a kicking speed of 10 m.p.h. in 130 ft. as against the oil-electric in 150 ft. The steam locomotive will require 11.4 sec. to reach 10 m.p.h. against the oil-electric of 16.7 sec.

"In a similar comparison using a 2,000-ton load, again the oil-electric locomotive will start faster than a steam locomotive, the steam locomotive will pass it in 50 ft., will obtain a kicking speed of 10 m.p.h. in 360 ft. against the oil-electric 730 ft., will do this in 46 sec. against the oil-electric 78 sec.

"Again in making comparisons, we have proven, at least to our own satisfaction, that the maintenance costs of all transportation units increase with age. We have definitely determined this rate of increase in so far as the steam locomotive is concerned. We have determined a similar increase in cost of the Diesel locomotive, based on the information published by the A. R. A., this being the only information we found available. Naturally, our study of steam locomotive repairs is based on a considerably greater number of units for a considerably greater length of time. Knowing the increasing cost of maintenance, it is a simple matter to determine the economic life of the unit, i.e., the length of time it should be kept in service before the annual increasing cost of repairs becomes greater than the decreasing amortization charge, and we believe that this is the correct period to use in comparison."

Unquestionably, as pointed out in the discussion at

the Western Railway Club meeting referred to, the Diesel locomotive has a definite place in the transportation field and its favorable progress will be expedited rather than hindered by avoiding any unfair or misleading comparison in specific cases.

Equipment Depreciation Rates

The rate at which equipment depreciation is to be charged to the operating expense accounts has all too generally been considered a matter for accountants and valuation engineers to worry about and of little more than academic interest to mechanical-department officers. However complex theoretical discussions of the subject may become, the use of a depreciation rate and a depreciation account has but one practical purpose and that is to provide a means by which the wastage of capital resulting from the operation of the property may be made good as an expense of the business.

There are at least three means by which the fact that capital is destroyed by time and its processes of change can be accounted for. In addition to depreciation accounting there is retirement accounting by which cumulative wastage is taken into account as an expense in a lump sum at the time a unit of property is finally disposed of by its owner. The third method by which the effect of this wastage is recognized is through the profit and loss account. This is the least desirable of the three methods, since it does not recognize capital wastage as an expense of the business, but as a loss, the effect of which is concealed from the stockholder until he suddenly has to face its full effect at the time final disposition of a unit of property takes place. All three forms of accounting are resorted to with respect to locomotives and rolling stock. In most cases the process involves a combination of depreciation and retirement accounting, with a growing tendency toward the use of depreciation and profit-and-loss accounting during recent years.

The cause of the wastage of capital has been the subject of much discussion and contention among engineers, accountants and lawyers. It is not the result of ordinary wear and tear. This is restored by repairs. In fact, it is physically quite possible to maintain a unit of property—a locomotive or a car—forever. Obsolescence, however, makes this progressively undesirable and ultimately economically impracticable.

The causes of obsolescence are not always easy to determine and have been less easy to evaluate. While the physical deterioration which comes with advancing age can be restored indefinitely, it seems evident that the process becomes constantly more expensive. Hence, in combination with advances in the art which make new units more efficient and capable of more effective performance, as well as the changing character of equipment needed to meet changing service requirements, the effects of advancing age in increasing maintenance costs in themselves become an important factor in producing obsolescence.

In any consideration of the method of accounting by which the wastage of capital caused by obsolescence may be made good, the important question is how fast does obsolescence develop. This is particularly important in the case of depreciation accounting. At the time of the purchase of an order of locomotives or cars how accurately can the rate of development of obsolescence be forecast? Is there, indeed, any good reason why a depreciation rate should be selected which will have completely made good the wastage of capital by the time it becomes desirable to retire a unit of equipment?

Obsolescence develops at varying rates at different times. The advent of steel car construction just before the turn of the century caused a sudden change in the future prospects of all of the rolling stock then in existence. That change in the art caused a rapid increase in the rate at which obsolescence accumulated on cars of wooden construction, while the new steel cars had a prospect of much longer useful life. Similarly, the advent of the stoker, the trailer-borne wide firebox and, more recently, the increase in firebox size permitted by the four-wheel trailer each reduced over night, so to speak, the duration of the prospective useful life of locomotives in existence at the time each of these developments became a fact. The recent advent of new materials of light-weight construction is doing the same to the future life prospects of the existing steel passenger equipment.

The depreciation rates set forth in Co-ordinator Eastman's report on the locomotive inventory of the Class I railroads, based on the form CP-2 questionnaire, indicates an appalling lack of imagination with respect to the future at the time most of these rates were set. An average of 2.19 per cent for the entire inventory, equivalent to an expected life of 46 years, indicates little appreciation of the inevitability of change—change which not only provides better cars and more efficient locomotives, but also destroys the usefulness of the old equipment units.

But why attempt to fix a rate by the exercise of imagination? Why not apply a nominal rate and, when desirable to retire the equipment, make heavy charges to the retirement account? This is obviously what must happen with a rate averaging 2.19 per cent on steam locomotives if the railroads are not to become generally obsolete because of the obsolescence of their motive power. The reason why this should not be done has become strikingly evident during the past four or five years when the managements of a number of railways, facing the issue of cumulative obsolescence in their equipment inventory which had long been side-stepped, found it necessary to resort to profit-and-loss accounting because operating expenses would not stand the heavy lump-sum charges to retirements entailed in the retirement of equipment by the customary accounting methods. The making of these charges in the profit and loss account, thereby reducing the apparent value of the stockholder's property, is an admission that the low depreciation rates of the past have given a false impression of the actual earnings of the property.

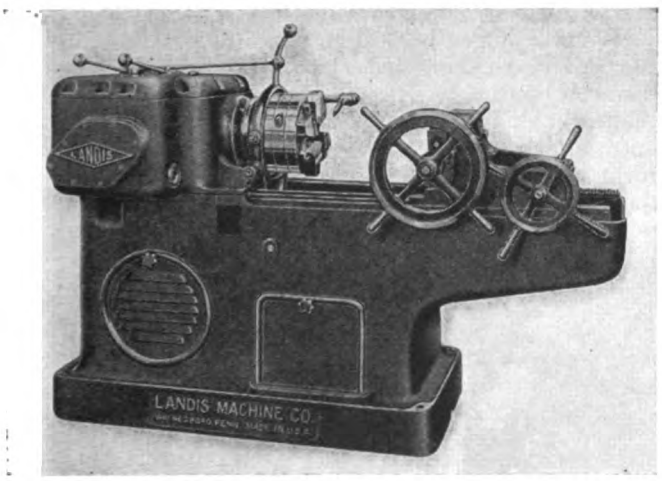
An adequate depreciation rate, even though at times it may completely restore the capital invested in a unit of equipment before it becomes desirable to retire it, will be better for the railways and the public alike than a low rate of depreciation which makes difficult the retirement of units until long after their obsolescence has become a burden on the operation of the property. If the rate is too large, the artificially high operating expense, in theory at least, places an unjustifiable burden on the shipping and traveling public. But if the rate is too low, the excessive cost of maintenance and operation entailed in keeping obsolete equipment in service is just as effective a burden on the shipping and traveling public—except as they chose to transfer their business to other modern transportation agencies. With such agencies now an important factor in the transportation field, the railroads must err on the side of a liberal policy with respect to depreciation to maintain their own competitive position and their ability to continue as an important servant of the public.

New

Shop Tools and Equipment

Threading Machines In Larger Sizes

THE Landis Machine Company, Inc., Waynesboro, Pa., is now offering the Landmaco threading machine in 2-in. and 2½-in. sizes in addition to the 1-in. and 1½-in. sizes built in the past. The new machines have capacities from ½ in. to 2 in. and ½ in. to 2½ in., respectively, and are made in both single-head and double-head models. Both sizes and models can be equipped with lead-screw attachments if desired. The larger threading machines are patterned closely after the smaller machines and have the same distinctive features of design, including the geared headstock with chrome-nickel steel gears, spiral bevel gear spindle drive,



Landis threading machine

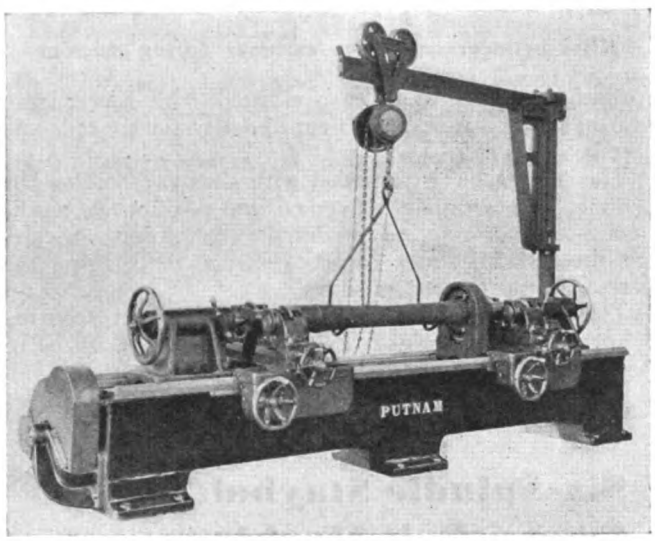
anti-friction shaft and spindle bearings, built-in reversible coolant pump, friction-clutch control, double wall bed, and covered guides. A wide speed range has been provided. All controls are centralized and within easy reach to provide maximum ease of operation.

Car-Axle Burnishing Lathe

THE Putnam Machine Company, division of General Machinery Corporation, Hamilton, Ohio, has recently designed a car-axle burnishing lathe arranged to burnish both journals at the same time. The machine has a carriage and a tail stock at each end, each carriage being fitted with a front and a rear burnishing tool. The burnishing rollers are self adjusting and as only one burnishing speed is supplied, the machine is quite simple. Both tail stocks are adjustable along the bed.

The two burnishing rolls are brought into action by a large screw operating in bronze nut. As the screw is not confined in the carriage end-wise but is free to float, the burnishing tools are forced against the journal with equal pressure and no end thrust is taken by the screw or the carriage. By setting the burnishing tools at a slight angle thev automatically feed themselves along the bed and stop when they strike the shoulder on the axle, thus no feed mechanism is required. The aprons contain only the gears and rack pinion for traversing the carriages by hand.

The machine is driven by a 5-hp. motor running at



Putnam car axle burnishing lathe

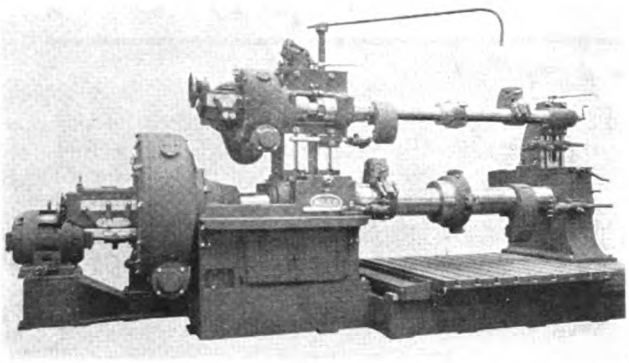
1150 r.p.m. and rotating the axle at a speed of 70 r.p.m. A crane is provided if so desired. The bed is 13 ft. 6 in. long and the floor space occupied is 14 ft. 6 in. by 4 ft. 8 in.

Cylinder and Valve-Chamber Boring Machine

THE Niles Tool Works Company, division of General Machinery Corporation, Hamilton, Ohio, has brought out a two-spindle boring machine designed to bore a locomotive cylinder and its valve chamber at one setting. The machine consists of a heavy bed and upright frame with the main spindle running in a permanent position. This spindle carries a 12-in. boring bar supported in an outboard bearing which is part of the table on which the cylinder casting rests. The height of the bar is 24 in. above the table. The spindle is arranged to be driven by a 25-hp. variable-speed motor running at 750 to 1,500 r.p.m. and geared to provide a main spindle speed of from 4 to 8 r.p.m. There are six feeds to the main bar, ranging from ⅛ in. to ¼ in. per revolution, obtained through a feed box fitted with sliding gears.

The valve chest boring spindle is mounted in a heavy casting and has an up-and-down and in-and-out movement to accommodate itself to the position of the valve

chamber. This spindle is driven by a 15-hp. variable-speed motor running at 775 to 1,550 r.p.m. and is geared to provide a spindle speed of from 8 to 16 r.p.m. The valve-chamber boring bar is 6 in. in diameter. The feeds are four in number and range from 1-16 in. to ½ in. per



Niles cylinder and valve chamber boring machine

revolution. Both spindles are fitted with taper front bearings to insure a smooth cut under heaviest feeds and speeds.

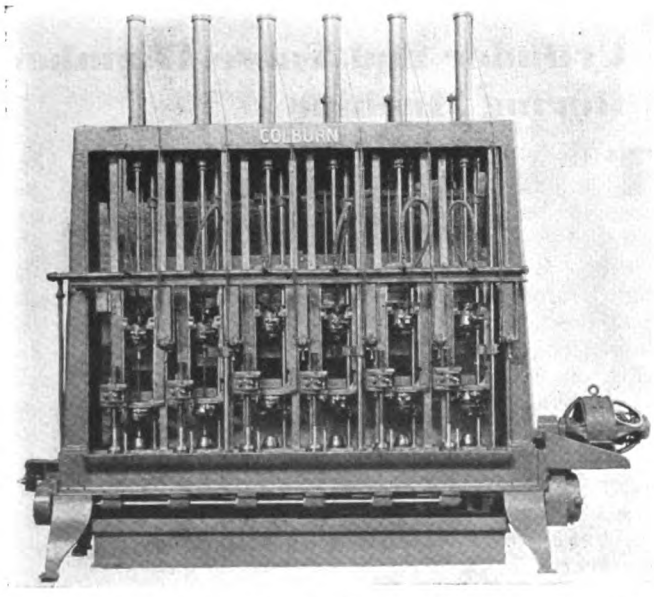
The work table is provided with slots for holding the cylinder and is rapidly traversed into position by means of a 3-hp. motor located under the main frame. Scales are fitted to all slides for convenience in bringing the bars into the desired position.

The floor space required for this machine for boring cylinders cast in halves is approximately 26 ft. by 10 ft. 9 in.

Six-Spindle Staybolt and Crown-Bolt Machine

A NEW design of the Colburn-Harrington six-spindle staybolt and crown-bolt turning and truing machine has been brought out lately by the Consolidated Machine Tool Corporation, Rochester, N. Y. This machine is arranged with three spindles for turning and three for threading, the first spindle to turn, the second spindle to thread, and alternating likewise on the other four spindles. Each head of the machine is equipped with a tandem carriage for the use of stationary self-opening turning and threading heads. The tandem carriages are equipped with air cylinders and separate hand controls for traversing the heads to and from the work. The turning heads are arranged with cutters for facing the underside of bolt-head flanges. The machine is equipped with an air feed and the feed rate is controlled by a dash-pot for the facing operation.

As shown, the machine is designed to be driven by a constant-speed direct-connected motor.

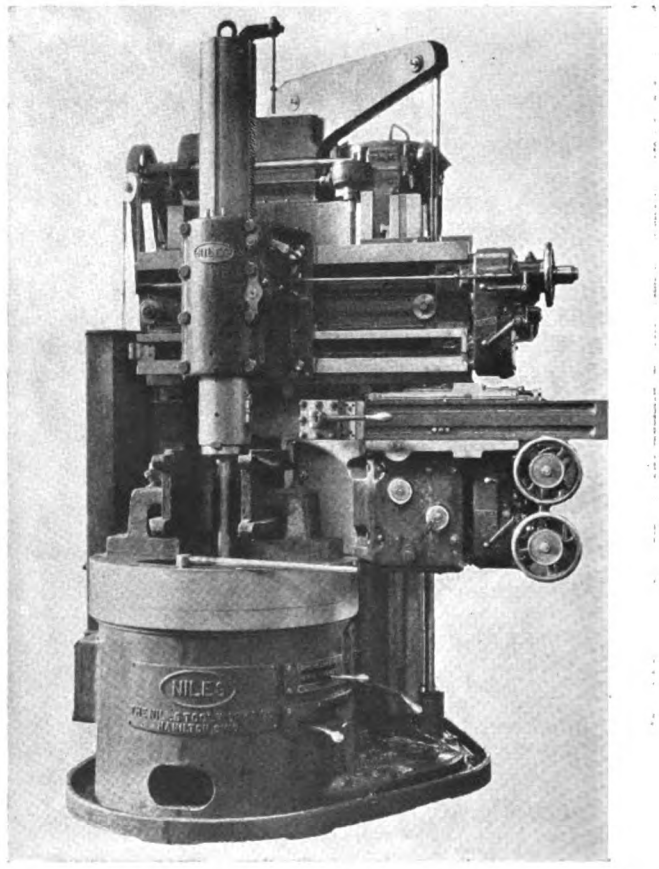


Colburn-Harrington six-spindle staybolt and crown bolt turning and threading machine

Driving-Box Boring, Burnishing and Facing Mill

THE Niles Tool Works Company, division of General Machinery Corporation, Hamilton, Ohio, has designed a special boring bar and self-centering table chuck for its 42-in.—50-in. boring mill, thus adapting it for boring, burnishing, facing and chamfering driving-box brasses ranging from 8½ in. to 13 in. in diameter and up to 21 in. in length.

The table is arranged with two self-centering chuck jaws and a hinged back stop, permitting the driving box to be entered into the chuck and serving also for diameter setting. The boring bar has an extension piloted in an anti-friction bearing in the table. A knock-out is attached to the saddle to limit the downward movement of the bar. The boring and chamfering tools and the burnishing roll are carried in the boring bar as will be noted from the illustration.

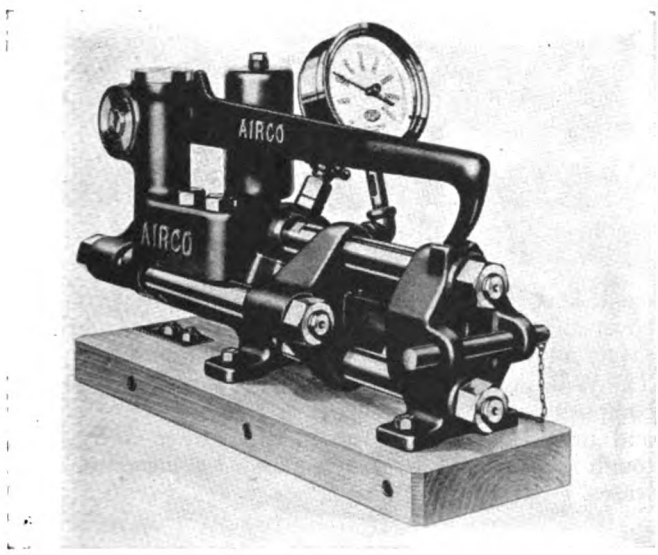


Niles 42-in.—50-in. boring mill fitted with a special boring bar and table chuck for machining driving box brasses

Portable Testing Machine For Welding Work

THERE is a growing demand for accurate knowledge of weld strength as a result of the developments in welding. To make it unnecessary to send specimens to a testing laboratory the Air Reduction Sales Company, 60 East Forty-Second street, New York, has developed the Airco portable tensile and bend testing machine which is a compact, comparatively light machine that can be carried to the welding job so that welded specimens can be tested on the spot, rapidly and easily.

The machine consists essentially of an oil pump, a hydraulically actuated piston or ram, two heads—one fixed and one movable—for gripping the test specimens, and four symmetrically located steel shafts, two of which transmit the piston motion and load to the movable head. The other two shafts maintain the alinement of the two heads and prevent the introduction of bending stresses in the tensile test specimen. By means of a



Airco portable tensile and bend testing machine

long lever attached to the pump and the ratio between the areas of pump plunger and hydraulic ram, the downward force on the pump lever is magnified 400 times in the load applied to the pump lever. This magnification, together with the large piston displacement of the pump, enables specimens to be tested rapidly and with a minimum of effort.

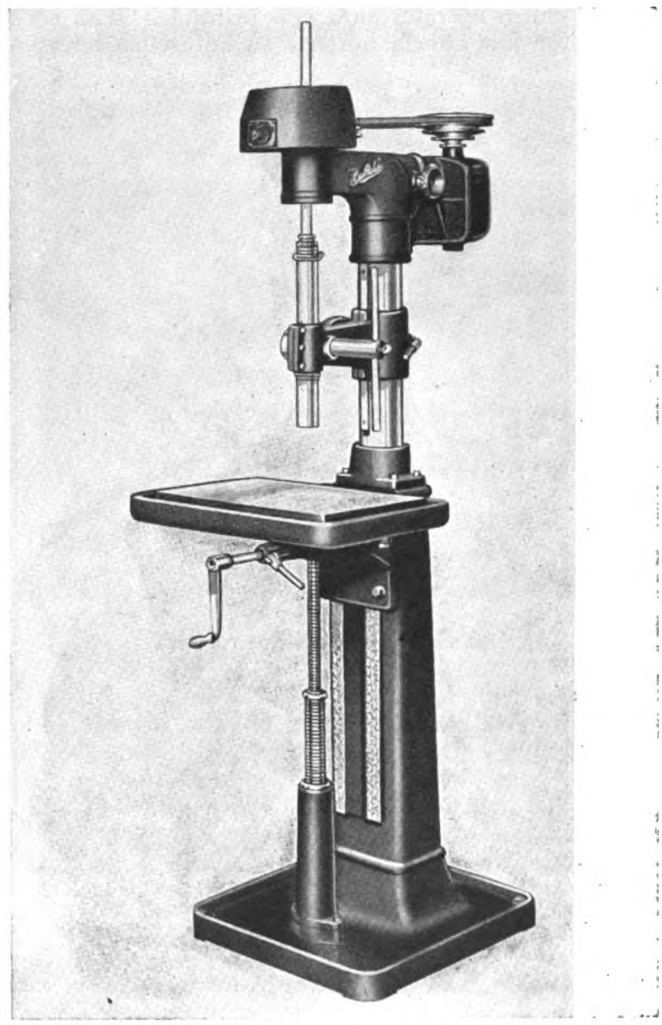
The load on the test specimen is indicated on a 6-in. pressure gage of special construction, carefully calibrated against a standard dead-weight tester. The gage is designed to maintain its accuracy under the strains of usage and shipping. Any good light crank-case oil can be used. The oil chamber is provided with a filter to prevent dust particles from entering the oil passages.

With a few strokes of the operating lever, after the specimen is set up, the operator can apply a direct load up to 40,000 lb. to specimens from 9½ in. to 10 in. long, up to ½ in. thick, and up to 1½ in. wide. Then, by using specimens of smaller cross-sectional areas, loads equivalent to 150,000 lb. per sq. in. or higher can be applied. With reduced size specimens the whole range of various types of steel can be tested. The stroke of the movable head is up to 2¾ in., more than ample for practically any ferrous or non-ferrous metals, and readings are accurate to plus or minus 2 per cent. For the bend test the machine is provided with an anvil which fits into the movable head and which bends the specimen against a pair of supports set 3 in. apart and cast integral with the body of the machine.

An important feature of this testing outfit is its easy portability. A solid hardwood base upon which the machine is permanently mounted forms part of the packing case, sides and top being assembled with screws. A separate box contains the gage carefully packed to protect it in transit. The entire unit, machine and case, weighs only a little more than 200 lb.

16-In. Motor-Driven Ball-Bearing Drill Press

AMONG the new machines recently placed on the market by the Buffalo Forge Company, Buffalo, N. Y., is a line of 16-in. ball-bearing drill presses in which the drive from the motor to the spindle is by



Buffalo 16-in. pedestal type drill press with V-belt drive

means of a V-belt. One design is of the floor type with a 4-in. diameter column on which the table is mounted. The table swivels around the column, may be tilted to

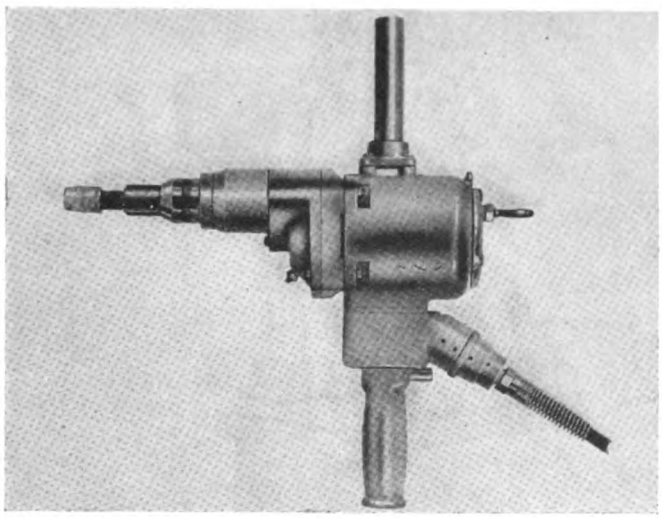
any angle, and has a vertical adjustment of 34½ in. Cup and V-center fittings are furnished for convenience in drilling shafts and odd shapes. Spindle feed is 5¾ in. with depth stop, or 7¼ in, without stop. Another form is the pedestal type (shown in the illustration) which has a table 14 in. by 18 in., with 28½ in. vertical adjustment. Designs are also available for bench mounting. Any model may be furnished with one, two, three or four spindles.

The motor regularly supplied is of ⅓ hp., 1,725 r. p.m. for single-phase, a.c. voltage and cycles as ordered. Other motors may be substituted if desired. The four spindle speeds range from 3,000 r.p.m. for ⅛-in. drills to 400 r.p.m. for ¾-in. drills.

Shockless Nut Runner

A SHOCKLESS high-frequency electric nut runner, with an adjustable releasing clutch which tightens the nut without shock to the operator, is being introduced by the Buckeye Portable Tool Company, Dayton, Ohio.

This clutch operates on a new principle. It is not a friction or jaw clutch, but has an adjustable releasing



Buckeye shockless nut runner

cam which trips open the clutch the instant the nut is tight. The size illustrated, the No. 30-N, is operated by an alternating-current motor, 3 phase, 180 cycles, 225 volts, and a speed of 750 r.p.m. It has a capacity for 5/16 in. and light ⅜-in. nuts. The length is 14 in. and the weight, 16¼ lb.

Cover-All Goggles

A NEW goggle for railroad service has been developed by Willson Products, Inc., Reading, Pa. This Willson cover-all goggle is designed to be worn over spectacles and is furnished in two styles, style CC50 having clear, super-tough (hardened) lenses for general chipping and grinding purposes, and style CW50 having welding lens and cover glass for over-spectacle use by welders. The higher cost of prescription hard-



Willson cover-all goggles

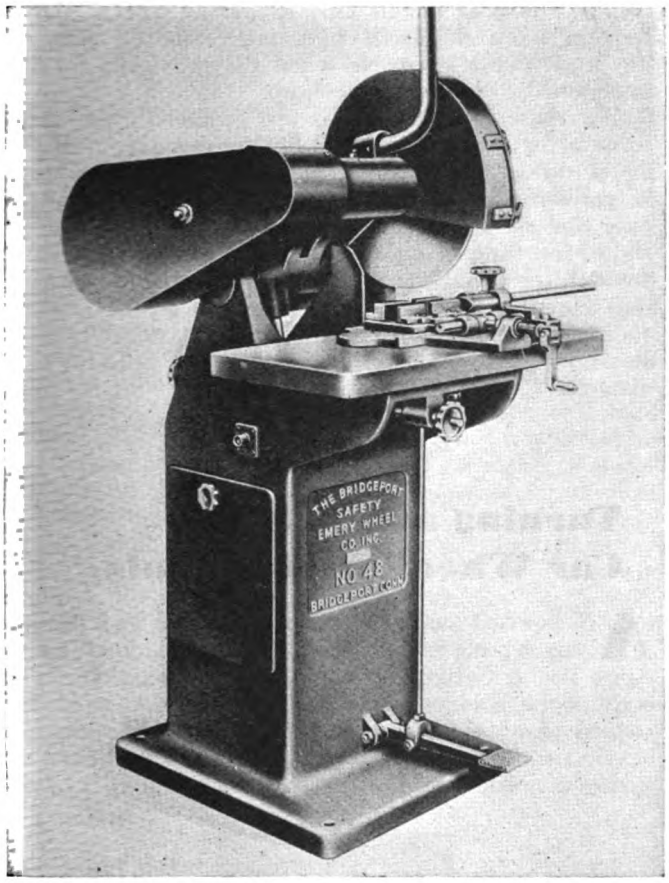
ened lens goggles compared to an over-spectacle or cover-all type, such as this new goggle, and the additional safety afforded have led to their adoption in many places. The Willson cover-all goggle is an anatomatically shaped, composition cup goggle, light in weight, well-ventilated, and furnished with a 50 m.m. lens, either clear, super-tough (hardened) or plate glass, welding and cover lenses.

Abrasive Cut-Off Machine

A NEW design of cut-off machine which employs an abrasive cutting disc has been brought out by the Bridgeport Safety Emery Wheel Company, Inc., 1270 West Broad street, Bridgeport, Conn. This machine, known as an "Abrasaw," is said to cut most sections within its capacity faster than by other methods and to cut readily many sections which can be done only with difficulty by other methods. Among the materials readily cut by this machine are such hard and tough metals or alloys as hardened tool steels, high-speed tool bits, drills or drill rods, Allegheny metal, non-ferrous alloys, asbestos products, Bakelite and fiber materials.

A 7½-hp. motor running at a speed of 5,200 r.p.m. drives the disc at a circumferential speed of 16,000 ft. per min. by means of six strands of V-belt of any standard make. The disc regularly furnished is 12 in. diameter, 3-32 in. thick, and has a 1-in. hole. Other sizes may be substituted if preferred. The disc guard is designed to give ample protection and the V-belt drive

is fully enclosed. The disc head and driving motor balance each other on a rocker shaft mounted in Timken bearings, sealed against entrance of grit. The standard vise takes sections up to 2½ in. and may be swiveled to provide for either straight cuts or angle cuts up to 45 deg. A special vise can be furnished for light sections



Bridgeport Abrasaw cut-off machine No. 48

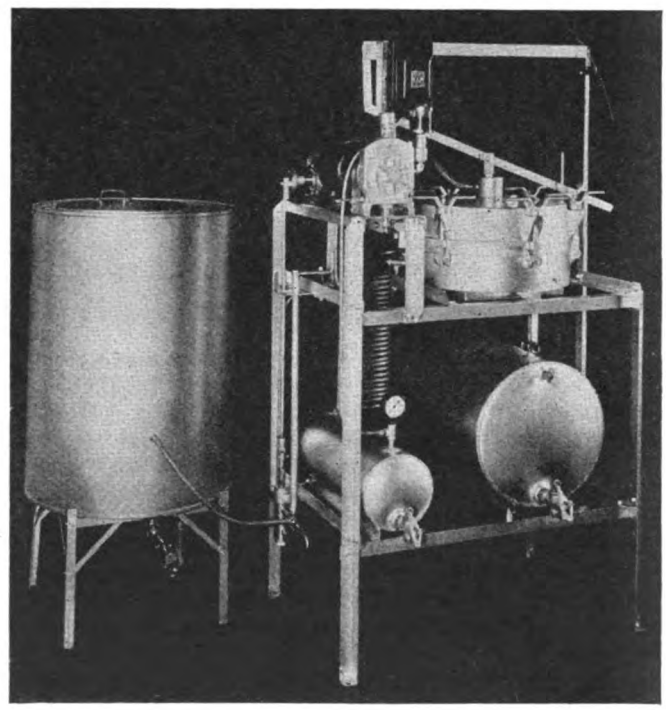
up to 3½ in. diameter. Clamping is accomplished by means of a draw rod and foot pedal, leaving both hands free for operating the swinging crank and handling the material being cut. The work is large and permits of different set-ups that may be required on various jobs. The floor space required is 36 in. by 40 in. and the weight of the machine is 1,020 lb.

Crank Case Oil Reclaimer

WITH the steadily increasing use of rail motor cars the disposition that is made of used crank-case lubricating oil is becoming a matter of even greater economic importance. It is universally known that this oil collects carbon dirt and metallic particles from worn parts of the engine and also becomes thinned by sundry diluents so that its lubricating value is greatly reduced. To keep down wear frequent drainage has become the general practice and the bulk of this used oil has been discarded as a waste product.

A number of years ago the Research Laboratories of the General Electric Company developed a process to cleanse and re-refine discarded crank-case oil on an economic basis. This process was more than filtration; it was rather refining, removing impurities and restoring the oil to its original viscosity and lubricating effectiveness. A license to use the process was obtained by the Hilliard Corporation, Elmira, N. Y. This company thereupon designed and marketed a group of oil reclaimers in three sizes, having a daily capacity of 8, 20 and 50 gallons, respectively. A number of these are installed at railroad shops for reclaiming crank-case oil from rail motor cars. In these reclaimers purification is carried on in two stages or operations. In the first stage the oil is clarified of solid impurities and the acids are neutralized by certain inexpensive chemicals mixed with the oil. The resultant sludge settles down and is carried off by an under-flowing current of water. In the second stage the oil flows over heated surfaces and the diluents are evaporated off.

The Hilliard Corporation has now developed a simplified machine of a small capacity which should extend the use of oil reclaimers into fields where the larger sized machines are not an economical investment. The machine, known as the Hilco oil reclaimer, is illustrated herewith. In operation drained crank-case oil is emptied into the tank at the left which has a capacity of 40 gal. The dirty oil is lifted by the small plunger pump shown near the bottom of the frame and delivered to the filter and evaporator after being preheated to make it run freely. A vacuum pump, driven by a ¼-hp. motor, keeps the system under a high vacuum. The oil is sucked through a bed of filtering material under the filter cover and through filter paper and canvas into the evaporator which forms the lower part of the assembly. The filter material cleans the oil, neutralizes the acid and decolorizes the oil.



The Hilco oil reclaimer

In the vaporizer the oil spreads out in a thin film over an electric heater, the temperature being thermostatically controlled at 380 deg. F. This relatively low temperature results in evaporation of dilution and moisture without any "cracking" of the oil itself. The finished oil runs into the larger tank on the frame from

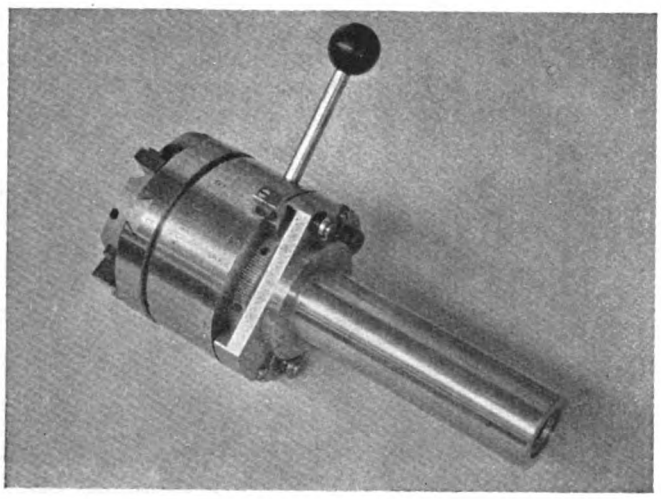
which it is drained off. Vapors coming off are condensed and collected as a penetrating oil in the smaller tank.

The machine, which weighs 600 lb. and occupies a floor space of 24 in. by 37 in., has a capacity of 10 gal. of cleaned oil per day, produced from about 12 gal. of dirty oil. The automatic process is continuous and requires only a brief daily servicing to drain off the clean oil and change the filter.

Stationary Type Tangential Dies

THE Jones & Lamson Machine Company, Springfield, Vt., has brought out a new line of stationary type J & L tangent dies. They are of the pull-off type and have several unique features in addition to those embodied in the J & L revolving type tangent dies, which have been on the market for several years.

The chaser holders are ground and lapped on the dovetails and take a wide bearing surface on the ground and lapped dovetail slots in the die body, as well as on the



Stationary type J & L tangential die

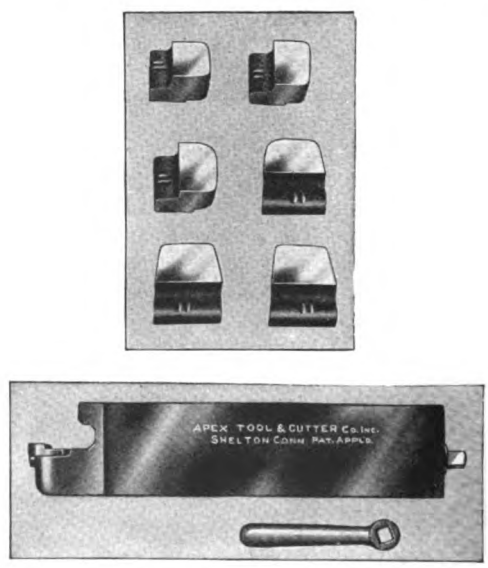
die body face. These holders can be changed, if necessary, without disassembling the die. These dies are locked by pushing the locking lever handle in one direction and may be tripped, when desired, by pushing it in the opposite direction. To make pitch diameter adjustments a spring operated pawl which engages teeth on the adjusting nut is raised and the adjusting nut moved to the proper position. After adjustment the pawl is permitted to settle back in the proper tooth where it securely locks the adjusting nut. The teeth on the adjusting nut permit adjustments of 0.00025 in. In addition to this, the diameter of the die plate adjacent to the adjusting nut is provided with wide-spaced graduations to permit adjustments of 0.001 in.

These dies are equipped with two springs, set up under a pre-determined pressure to permit a cushion start, thus eliminating the solid impact of the chasers and work. The dies are also provided with a longitudinal float which permits the chasers greater freedom to reproduce their own accuracy. The driving flange is screwed onto the shank and dowelled in place, thus affording a drive at a point farthest from the center of the die. This driving arrangement also permits eccentric float to take care of misalinement of the die and work. The amount of eccentric float is determined by the clearance allowed between the outside diameter of a shank integral with the die body and the bore of the outer shank sleeve. On most machines requiring stationary dies, such as hand screw machines, turret lathes and Cleveland automatics, a long shank may be employed. By controlling the float in this long shank the face of the die remains more closely at right angles to the center of the work than is possible when the provision for float is confined to a shorter hook-up.

The chasers for these dies are ground in the thread form at the exact helix angle for the diameter and pitch of the thread to be cut. All chasers are interchangeable in revolving and stationary dies of the same capacity, only one set of chaser holders being required for any right-hand threads within the rated die capacity, whether standard or special, and regardless of diameter or pitch, thus eliminating numerous chaser holders. These new stationary type J & L tangent dies are available in five sizes, with a threading range from No. 8-32 to 2 in. diameter.

Turning and Dressing Car Wheel or Tire Tools

AN inserted tool and holder for turning and dressing car wheels and tires has been developed by the Apex Tool & Cutter Company, Inc., Shelton, Conn. The body of the holder is made of chrome nickel steel, heat treated to toughen it so as to permit of its taking the heaviest shocks. The seat of the holder is hardened, assuring a satisfactory bearing so the tool bit will have a



Apex tool holder and bits for turning and dressing car wheels and tires

perfect seat. This combination of steels is necessary for the conditions each must satisfactorily perform.

The tool bit, which is ground for right- or left-hand use, is inserted from the front of the holder after the lock is loosened sufficiently to allow space for its shank to seat at the shoulder and is first used in the central position slot. It can be drawn in by the screw at the rear of the holder and locked in a firm position within a few seconds. The tool bits are forged of special

analysis high-speed steel or cobalt steel in confined dies. After forging they are finished to size, heat treated and ground, being furnished ready for use. The illustration shows a holder made in standard sizes to fit Niles, Sellers or Putnam wheel lathes, and the standard roughing tools, right or left hand. All tool bits are interchangeable, it being unnecessary to remove the holder from the tool post when changing bits.

A small radius tool is also shown, either right or left hand, which is suited for turning tires or wheels with hard spots or nigger heads. As it will undercut easily and will save considerable regrinding and waste of tool bits, it is recommended as an emergency tool when such conditions arise. The changing of bits is so simple and easy that practically no time is lost in following this procedure.

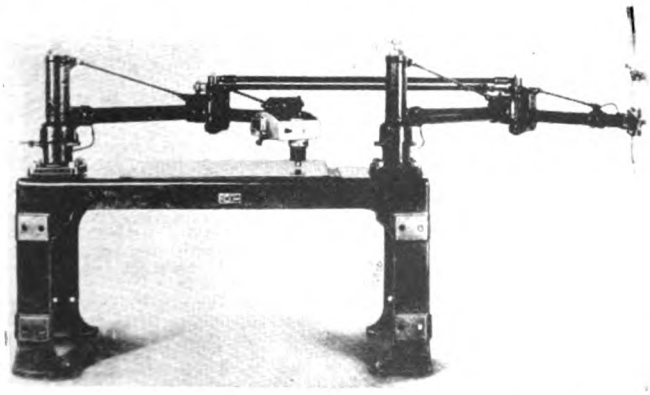
When a tool becomes worn and clearance from regrinding it lost, additional slots or stations for locating the tool bit are provided so that the tool bit is stepped out sideways to the next slot, thereby extending the life three to four times that of an ordinary tool. Considerable additional wear can be had from this adjustable feature. The Apex tool has the rigidity of a solid tool and the combined steels used in the complete unit have greatly improved the cutting and performance ability by applying the proper steels for the particular services each must perform.

A grinding holder or machine fixture for redressing worn tool bits is also available so that tool rooms can maintain the proper angles recommended for the tool bits.

Standard holders are likewise used for the axle lathe with interchangeable tool bits for machining the 1/8 in. and 3/4 in. radius required, either right or left hand, without changing the tool bit, and roughers are used in the same holders when necessary.

Pantograph Type Gas-Cutting Machines

THE Air Reduction Sales Company, New York, has added to its line of pantograph type gas-cutting machines two new units, designated as Airco-DB No. 7 Oxygraph and No. 1 Travograph, respectively, which enlarge the range and scope of machine gas cutting. The



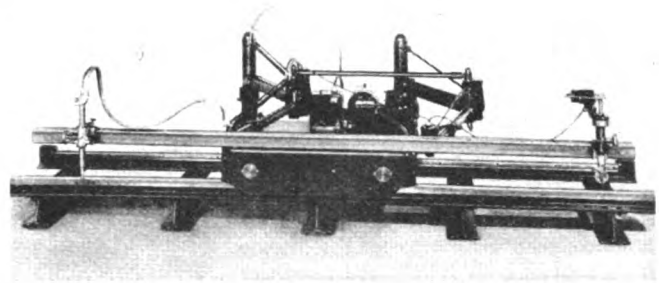
Airco DB No. 7 Oxygraph gas-cutting machine

basic principle of operation of these two machines is the same as that of the No. 6 Oxygraph previously introduced.

The No. 7 Oxygraph, however, employs a different pantograph construction, the fourth side of the parallelogram being removed to the rear. This arrangement allows the working ends of the arms to swing between the vertical posts which support the pantograph assembly, as well as in back of them, and permits covering a maximum cutting area with a given length of arms. No tracer bar is required, the tracer being attached to the end of one pantograph arm and the cutting torch to the end of the other arm. It is designed for single-torch operation only. The tracing table for holding the full-scale drawing is part of the machine and is located on top of the bed between the vertical posts. A manually controlled tracer unit with its adapter is supplied as standard equipment.

In the No. 1 Travograph, the pantograph assembly is mounted on a carrier that travels on rails and thus greatly extends the cutting area. It is fitted with a long tracer bar attached to the outer ends of the pantograph arms. The tracer mechanism and cutting-torch holders are mounted on this bar and may be moved to any position along the bar and secured in place by set screws. As many as six cutting torches may be mounted for multiple cutting. The No. 1 Travograph can also be operated with either manually controlled or magnetic tracer.

Automatic control of the carrier driving motor by the movement of the pantograph arms is a feature of the machine. As these arms reach certain limiting positions in either direction they operate switches which actuate the magnetic reversing starter of the carrier motor. In this way the carrier is automatically positioned to the



Airco DB No. 1 Travograph gas-cutting machine

most advantageous location at all times. The position of the tracing device, its speed and direction of travel automatically control the direction and extent of travel of the carrier.

The electrical circuit provides for giving the carrier driving motor a slow starting speed and smooth pick-up, thus eliminating any jarring of the tracer bar. The motor is of the variable-speed type controlled by adjusting the speed governor screw. At each end of the carrier base a limit switch opens the motor circuit and brings the carrier to a gentle stop. The drive can be disengaged by a clutch, which permits quick positioning of the carrier along the track. The rails on which the carrier runs are 16 ft. long with tops or threads accurately machined. They are bolted to five H-beam sections which serve as ties and supports for the machine. Additional 16-ft. lengths may be added if required.

Straight lines, circles and regular or irregular shapes are cut in steel plate, slabs, billets and forgings by either machine. The cutting area or range of the No. 7 Oxygraph is a 30-in. square or a 36-in. diameter circle, while that of the No. 1 Travograph is a rectangle 4½ ft. in width and 11 ft. in length, with one 16-ft. section, or any length desired with additional rail sections.

Among the Clubs and Associations

MECHANICAL DIVISION, A. R. A.—In view of present business conditions, it has been decided that there will be no annual meeting of the Mechanical Division, A. R. A., for the year 1934. In lieu of an annual meeting the General Committee will hold a meeting at 10:00 A. M., Wednesday, June 27, at the Congress Hotel, Chicago. At this meeting, the General Committee will consider reports from the committees of the Division, and attendance will be limited to the chairmen of committees and sub-committees that have recommendations to submit for consideration. There will be no advance printing and distribution of committee reports, with the exception of the reports from the Arbitration Committee and Committee on Prices for Labor and Materials. Reports will be presented to the General Committee in mimeographed form and only those reports or portions of reports which the General Committee shall direct be submitted to letter ballot or be submitted to the members for information will be printed following the meeting. Any member railroad may be represented at this meeting if they so elect.

WESTERN RAILWAY CLUB.—The principal feature of the fiftieth annual dinner of the club, held Monday evening, May 21, at the Hotel Sherman, Chicago, was an address by Samuel Vauclain, chairman of the board of directors of the Baldwin Locomotive Works. In discussing the subject "What Size Wheels?", Mr. Vauclain presented some unusually interesting figures and slides showing the trend toward a common size for locomotive driving wheels used in both freight and passenger service. He stated that the time is apparently ripe for the adoption of one standard size wheel for road locomotives, namely, 72-in. wheel centers, with 3-in., 3½-in. or 4-in. tires. ¶A brief business meeting of the club was held after the dinner, the following officers being elected for the year 1934-1935: President, A. N. Williams, president and general manager, C. & W. I.; first vice-president, L. Robinson, assistant to general superintendent of motive power, Ill. Central; second vice-president, D. C. Curtis, chief purchasing officer, C., M., St. P. & P.; secretary, C. L. Emerson, division master mechanic, C., M., St. P. & P.; and treasurer, J. W. Fogg, MacLean-Fogg Lock Nut Company. New members were elected to the board of directors, which now consists of: W. A. Bender, master car builder, Alton; J. E. Buker, Vapor Car Heating Company; J. T. Gillick, vice-president, C., M., St. P. & P. H. P. Allstrand, principal assistant superintendent of motive power and machinery, C. & N. W.; C. T. Ripley, chief mechanical engineer, A., T. & S. F.; G. F. Slaughter, American Steel Foundries; P. J. Colligan, general superintendent of motive power, C., R. I. & P.; O. E. Ward, superintendent of motive power, C., B. & Q.; L. R. Wink, assistant superintendent of the car department, C. & N. W.; E. E. Thulin, Duff-Norton Manufacturing Company; F. G. Gurley, assistant to vice-president, C., B. & Q.; and retiring president, J. E. Bjorkholm, assistant superintendent of motive power, C., M., St. P. & P.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The session of the Railroad Division at the spring meeting of the A. S. M. E., to be held June 25-28 at the Cosmopolitan Hotel, Denver, Colo., will be on Wednesday morning, June 27, at which the following papers will be presented: Light-Weight Stainless Steel Burlington Zephyr, by E. C. Anderson, mechanical engineer, C. B. & Q.; Considerations Relating to the Design of Light-Weight Trains Exemplified by the Burlington Zephyr, by Dr. R. Eksergian, consultant engineer, Budd Manufacturing Company, and The Union Pacific Light-Weight Railway Train of Aluminum Alloy Construction, by A. H. Fetters, general mechanical engineer, Union Pacific System.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—In discussing the subject "Accident Prevention in the Car Department," at the May 14 meeting of this association, W. E. Dunham, superintendent of the car department of the Chicago & North Western, stressed the necessity of continued, faithful efforts if satisfactory results in safety work are to be obtained. He presented some interesting facts and figures showing the reduction of accidents on railroads generally, and on the Chicago & North Western car department in particular, emphasizing the need of adequate instruction in first aid in order to minimize the harmful effect of such accidents as may occur. In this connection, a unique and instructive feature of the evening's program was a demonstration of first aid by a picked team of car-department employees representing the C. & N. W.

Directory

The following list gives names of Secretaries, dates of next regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 2205, 150 Broadway, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—Division V.—MECHANICAL.—V. R. Hawthorn, 59 East Van Buren street, Chicago.

Division V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorn, Chicago.

Division VI.—PURCHASE AND STORES.—W. J. Farrell, 30 Vesey street, New York.

Division I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

Division VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Columet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, Room 332, 30 Church street, New York. Spring meeting, Denver, Colo., June 25-28.

MACHINE SHOP PRACTICE DIVISION.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—Edgar J. Kates, 1350 Broadway, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, La Salle Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth street, Council Bluffs, Iowa. Regular meetings, second Tuesday of each month at Council Bluffs.

CENTRAL RAILWAY CLUB OF BUFFALO.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month except June, July and August, at Hotel Statler, Buffalo.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon, 12:15 p. m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha street, Winona, Minn.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md. Annual meeting October 17-18, Hotel Stevens, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—C. L. Emerson, 822 Straus Building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

NEWS

THE CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC has placed on order with the Timken Roller Bearing Company, Canton, Ohio, for bearings and boxes for 50 passenger coaches which the railroad is building in its Milwaukee shops.

THE LOCOMOTIVE FIREBOX COMPANY has received an order from the Delaware, Lackawanna & Western for 20 sets of three syphons each for application to the twenty 4-8-4 type locomotives which this road has ordered from the American Locomotive Company, as reported in the May issue.

THE DELAWARE, LACKAWANNA & WESTERN has placed an order with the Barco Manufacturing Company, Chicago, for float-type low water alarms to be applied to the twenty 4-8-4 type locomotives recently purchased. The Northern Pacific is equipping 10 of its new locomotives with the Barco new water alarm, and five of these locomotives will be equipped with Wilson feedwater conditioners which are using Barco 6-in. flexible connections between the locomotive and the feedwater conditioner on the tank.

Burlington "Zephyr" Non-Stop Run

LEAVING the Union Station at Denver, Colo., at 5:05 a. m. (Mountain Time), on May 26, the "Zephyr," new stainless steel, stream-lined train of the Chicago, Burlington & Quincy, made a non-stop run of 1,015.4 miles to Halsted street, Chicago, in 13 hr. 5 min., or at an average speed of 77.5 miles per hour for the entire distance.

The fuel consumed on the run amounted to 418 gallons, the approximate cost of which was $16.

Not only were innumerable records broken during the course of the run, but also the dependability of the train and of the Burlington track were given a thorough and satisfactory test. The longest previous non-stop run, 401 miles, on the L. M. S. Ry. of England, was exceeded more than two and a half times, and all records for average speed for stretches of 200 miles and over were excelled.

Among the highlights of the speed records were the following:

Maximum speed attained: 112.5 m.p.h.

Yuma, Colo., to Schramm, 6.4 mi., 3½ min., average speed, 109.0 m.p.h.

Otis, Colo, to Schramm, 19.1 mi., 11 min., average speed, 106.2 m.p.h.

Otis, Colo., to McCook, Nebr., 129.5 mi., 86 min., average speed, 90.0 m.p.h.

To compensate for the slower speeds through the larger cities, it was necessary to traverse 215.7 miles at an average rate of more than 90 m.p.h., of which 19.1 miles was traveled at more than 100 m.p.h.

Progress in Air-Conditioning Programs

Road	No. of cars	Type of car	Type of system	Builder
B. & O.	16*	Pass.	Built-in duct type	York Ice Machy. Corp.
Union Pac.	1	6-car train†		
	2	9-car train†	.....	Frigidaire Corp.

* These cars have been ordered from the American Car & Foundry Co. as noted in the New Equipment table.

† The order for these trains, as noted in the March issue, was placed with the Pullman Car & Mfg. Corp., through whom the order for air-conditioning equipment has been placed.

The regular schedule between Denver and Chicago is 26 hr. 15 min. In 1897 a special train, ordered by Henry J. Mayham of Denver, to reach the bedside of his dying son, made a westbound run—from Chicago to Denver—in 18 hrs. 35 min.

An average speed of 80.2 miles an hour was maintained by Zephyr on May 10 on a 140-mile run from Fort Wayne, Ind., to Englewood station in Chicago, over the Pennsylvania. This rate was accomplished against a head wind which measured 39.8 miles an hour at Fort Wayne.

Triumph of Air-Conditioning

THE BALTIMORE & OHIO reports that its Capitol Limited—Chicago to Washington, 825 miles in 17½ hours—traveled through the country-wide dust storm of May 10, throughout the whole of its trip, and the passengers came through in a condition of "complete cleanliness;" in other words, the air-conditioning system, with which the train is equipped, had functioned perfectly. The accumulation of dust in the intake boxes was equal to the quantity usually taken up in two weeks.

A Million Visitors to the U. P. Train

A TOTAL of 1,195,609 persons passed through the Union Pacific's high-speed streamlined train during its two months' exhibition tour of 65 cities. The tour ended on May 5. The train covered a total of 12,625 miles, and traveled on the rails of 14 different railroads, in addition to those of the five units comprising the U. P.

Every sort of climate was experienced. In the East, temperatures as low as 10 deg. below zero were encountered, while on the Pacific coast as high as 92 deg. above was experienced. Snow, high winds, rain and dust storms were met at different points.

The train traveled in every sort of situation. Every grade was made at the highest speed set for it in regular service, some of the grades being as high as five per cent, and all were made at half

New Equipment

CAR ORDERS

Road	No. of cars	Type of car	Builder
B. & M.	10[1]	De luxe coaches	Pullman-Bradley Car Corp.
	21[2]	Suburban	Pullman-Bradley Car Corp.
B. & O.	16[1]	Passenger	American Car & Fdry. Co.
C. G. W.	500[1]	50-ton box	Pullman Car & Mfg. Co.
N. Y. N. H. & H.	3[3]	Articulated Diesel-elec.	Goodyear Zeppelin Corp.

CAR INQUIRIES

D. T. & I.	15	55-ton steel covered hopper, for bulk cement	.....
Pennsylvania Water & Power Co.	1	160-ton transformer	.....
	1	110-ton transformer	.....

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
B. & M.	5[4]	4-6-2 pass.	Lima Loco. Works
	5	4-8-2 frt. and pass.	Baldwin Loco. Works
	1[4]	Diesel-elec. road loco. unit or motor car	Bethlehem-Westinghouse
	1[4]	Diesel-elec. road loco. unit or motor car	St. Louis; Ingersoll-Rand; Gen. Elec.
	1	Diesel-elec. switch.	McIntosh & Seymour; American Loco.; Gen. Elec.
	1	Diesel-elec. switch.	Ingersoll-Rand; Gen. Elec.

LOCOMOTIVE INQUIRIES

Aliquippa & Southern	1	0-8-0 switch.	.....
Mo. Southern	1[5]	Oil-elec. or gas-elec.	.....

[1] To be purchased with money loaned by the P. W. A. The B. & O. cars are for the streamlined trains reported in the May issue.

[2] These coaches, which will be financed in part by a loan from the P. W. A., will be of a new type, seating 96 persons. They will be constructed of lightweight alloy steel weighing approximately 84,000 lb. as compared with a weight of 130,000 lb. of the latest type coaches now in service. The cars will be equipped with roller bearings, and will have insulated trucks. The ten de luxe coaches will also have insulated trucks and roller bearings and will be air conditioned.

[3] According to the announcement of the New Haven these cars will constitute a train which will be built of Duralumin, ultra streamlined and air conditioned throughout. The cars will be suspended on shock absorbers, and will have a Diesel-electric power unit at each end. The floor height above the rail will be 31¼ in., only two shallow steps being necessary to enter the car. The car will be approximately 11 ft. 3 in. high, this being about 20 per cent lower than present standard equipment.

[4] The five new 4-6-2 type locomotives will be equipped with boosters. The two Diesel-electric road locomotive units or motor cars, each of 800 hp. will be of streamlined design. They will be of a three-compartment type, the forward compartment containing the motive power equipment, the middle a mail-handling compartment, and the rear a baggage compartment. Each of the units will be capable of hauling five coaches as trailers. P. W. A. allotments have been made for the equipment to be purchased by the B & M.

[5] To be financed in part by a loan from the P. W. A.

throttle. From sea level the train went to altitudes as high as that of Sherman Hill, Wyo., 8,013 ft. above sea level. At no time did the train need assistance of any kind.

No attempt was made at any time to test the train for speed. However, it was run on the schedules of the fastest trains of the different railroads traversed. Just west of North Bend, Neb., the train did one mile in 33 sec., a rate of 109.3 miles per hour. Its general average speed was well above 70 miles and most of the running between stations was at about 80 miles an hour. In a special test run recently the train registered 111 miles an hour.

On April 19, the train made its first revenue trip—a two-day tour to Gering, Neb., sponsored by the Omaha Chamber of Commerce.

P. W. A. Loans to Railroads

THE PUBLIC WORKS ADMINISTRATION has announced that actual disbursements to the amount of $43,590,000 had been made by it up to May 15 on its loans to railroads, on allotments amounting to $199,607,000. The borrowing companies draw their loans down as they require money to meet payrolls on work being done by their own forces and to pay for materials, rails, engines, and cars, as delivered. Material and rail manufacturers, and locomotive and car builders, finance themselves until they are ready to make delivery. At delivery time the railroads requisition money from the P. W. A. and pass it along to the manufacturers. Approximately $85,000,000 of the allotments is being used for new cars and locomotives.

Equipment repair, which is but a small part of the P. W. A. railroad program, will result in the payment of $11,525,000 in wages to railroad shopmen who make the repairs and the purchase of $15,790,000 worth of materials.

Loans for equipment repairs have been made to the following railroads: Baltimore & Ohio; Boston & Maine; Delaware, Lackawanna & Western; Great Northern; Illinois Central; Lehigh Valley; Southern Pacific; Chicago, Milwaukee, St. Paul & Pacific; New York, New Haven & Hartford; Wabash (receivers); Erie; Interstate. In the shops of these companies 1,552 locomotives, 1,956 passenger cars and 33,323 freight cars will be repaired.

Among the more recent contracts signed are the following:

Boston & Maine.—$1,550,000 to be used for a general program of roadway improvement. This is the third such loan to the Boston & Maine to be placed under contract. A fourth contract calling for a loan of $2,628,000, to be used for the purchase of new locomotives and cars, is in course of preparation. The total of all four loans will be $7,318,000.

Chicago Great Western.—$1,200,000 for the purchase of 500 box cars.

Delaware, Lackawanna & Western.—$1,043,000 for conversion of a locomotive and cars.

Grand Trunk Western.—$250,000 for rail and fastenings.

Great Northern.—$850,000 for rebuilding 650 refrigerator cars in its shops at St. Cloud, Minn. This is the second contract signed for this road, the first being for $4,935,000 as noted in the April issue.

Gulf, Mobile & Northern.—$210,000 for the building of 100 freight cars.

An allotment of $36,000 has also been made to the Missouri Southern to be applied toward purchase of a Diesel-electric locomotive.

Supply Trade Notes

THE VAPOR CAR HEATING COMPANY, INC., has moved its office from 75 West street to 230 Park avenue, New York City.

J. G. WALLACE, representative of the railway sales division of The Texas Company (California), Hearst building, San Francisco, Cal., has been appointed assistant district manager.

A. F. KING, formerly with the Buffalo, N. Y., and Philadelphia, Pa., district sales offices of the Reading Iron Company, has been transferred to Boston, Mass., as district sales representative, succeeding John G. Ross, who has resigned.

THE RAILS COMPANY, 50 Church street, New York, has been appointed general sales managers for the Sterling Fibre Company, Waltham, Mass., manufacturers of car seats and wool padding material. The offices of the Rails Company were formerly at 405 Lexington avenue, New York.

GEORGE H. ORD has been appointed eastern sales manager, with headquarters at 501 Fifth avenue, New York, of the Ewald Iron Company, Louisville, Ky. Mr. Ord was for many years vice-president of The Ellcon Company, New York, and sales representative of the Morton Manufacturing Company, Chicago.

SAMUEL E. HACKETT, vice-president in charge of sales of the Jones & Laughlin Steel Corporation, has been elected president, with headquarters at Pittsburgh, Pa. Mr. Hackett succeeds George Gordon Crawford, who has resigned as president but will continue as a director and a member of the executive committee.

J. F. FRANEY has been appointed sales manager of the Pilot Packing Company, with headquarters in the Peoples' Gas Building, Chicago. Mr. Franey will have



J. F. Franey

full charge of sales in the Chicago and adjacent territory. He served an apprenticeship as a machinist with the C. B. & Q. and later was with the American Locomotive Company at its Schenectady, N. Y., works on a special assignment. He then was appointed general foreman on the N. Y. C. and subsequently was mechanical inspector on the L. & N. During the war he was with the American Brake Shoe & Foundry Company, at Erie, Pa., engaged in supervising the manufacture of munitions. He left that company to go to the D. & R. G. in charge of its Denver, Colo., shops. For the last seven years Mr. Franey has been engaged in selling and servicing mechanical engine packings to railroads in the Chicago territory.

H. L. ANDREWS, Erie, Pa., has been elected a vice-president of the General Electric Company, in charge of the activities connected with the electrification of steam railroads and such other duties as may be assigned to him by the presi-



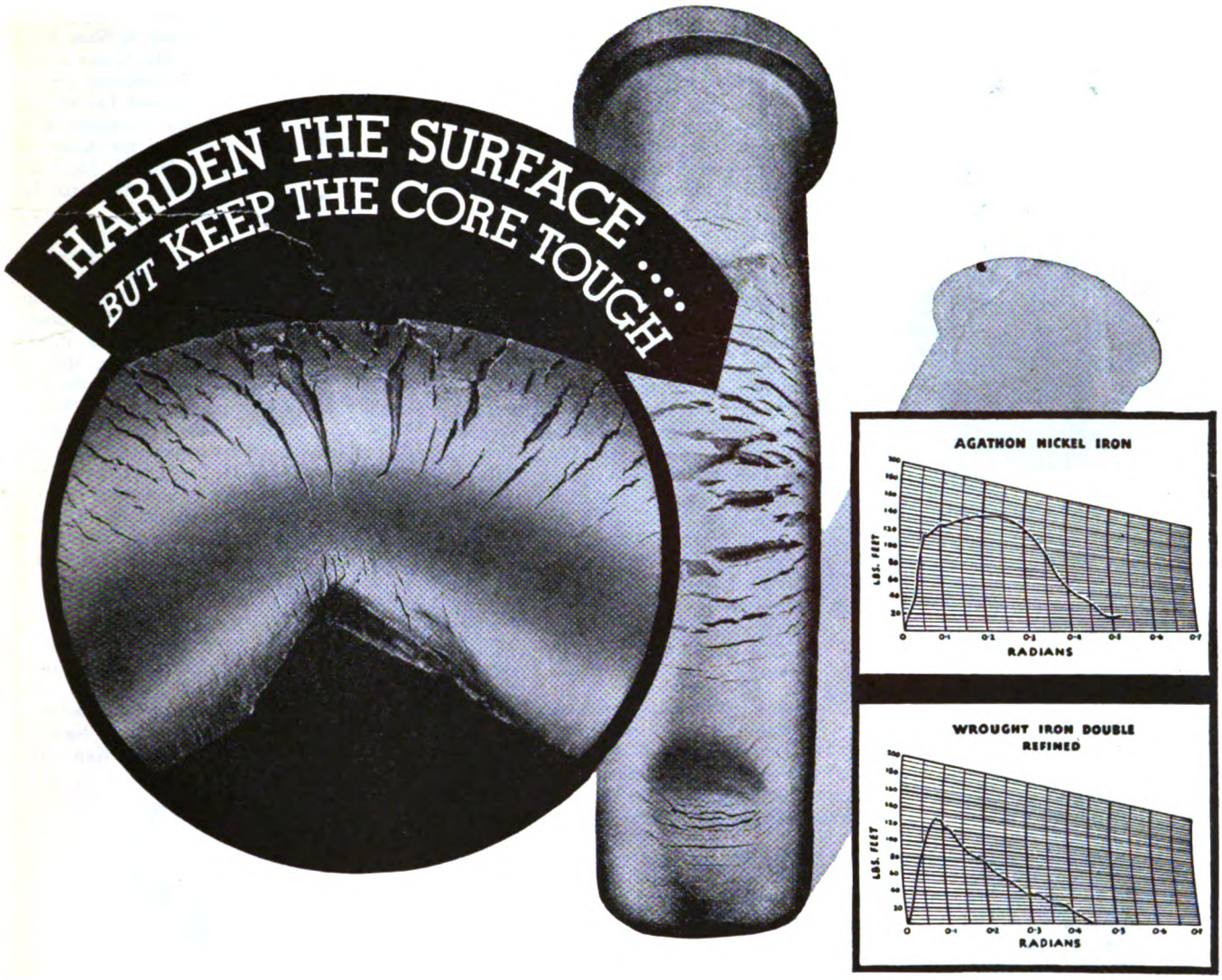
H. L. Andrews

dent. Mr. Andrews was graduated from the University of Missouri in 1910, and the same year entered the testing department of the General Electric Company. In 1912, he was transferred to the railway motor department and in 1916 to the railway engineering department. A year later he was placed in charge of car equipment. Late in 1925 he was appointed assistant engineer in administrative charge of the department and in 1929 became engineer. Recently he has also been responsible for general commercial matters in the transportation field, and now is vice-president in charge of the activities connected with the electrification of steam railroads and such other duties as may be assigned to him by the president.

R. B. MILDON, who has been elected vice-president of the Westinghouse Electric & Manufacturing Company, with headquarters at South Philadelphia, Pa., in charge of the operations of marketing, engineering, manufacturing and service in connection with the products of the South Philadelphia works, was graduated from the civil engineering school of Cornell University in 1900. Shortly thereafter he was employed by the Union Pacific and the Colorado Fuel & Iron Company in an engineering capacity. In 1906 he was appointed chief engineer of the Duquesne Mining Company, and three years later became associated with the Westinghouse

(Continued on next left hand page)

HARDEN THE SURFACE .... BUT KEEP THE CORE TOUGH



Wearing parts such as valve motion pins and bushings need a glass hard surface for long life with an interior toughness to resist shock. » » » How well Republic metallurgists succeeded in developing in Agathon Nickel Iron a material that combines these conflicting qualities is shown in the above curves. » » » The Humphrey Machine which produced these charts, bends the full section to the breaking point of the case and then on to final rupture. The first break in the line indicates the point at which the case was first cracked; the rest of the curve shows the resistance of the core to rupture. » » » The core of the wrought iron shows rapidly diminishing resistance as the angle of bending increases. » » » Agathon Nickel Iron, on the other hand, shows stubborn resistance even after the case is broken. The core is tougher and uniform in composition. » » » Use Agathon Nickel Iron for all case-hardened parts. » » » » » » » » » » » » »

Toncan Iron Boiler Tubes, Pipe, Plates, Culverts, Rivets, Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel.

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES YOUNGSTOWN, OHIO

AGATHON NICKEL IRON

company in charge of the gas producer department of its machine works at East



R. B. Mildon

Pittsburgh, Pa. In 1912 he was transferred to the Westinghouse Air Spring Company and in 1916 re-entered the employ of the Westinghouse Electric & Manufacturing Company as assistant to vice-president. Recently he had been in charge of the stoker department.

ARTHUR H. SMITH, formerly vice-president of the Railroad Materials Corporation, has joined the Youngstown Sheet & Tube Company, Youngstown, Ohio, as special representative of railroad sales in



Arthur H. Smith

the East. Mr. Smith will have his headquarters at New York, and will cover the territory east of Youngstown from Maine to Florida. He is well acquainted with steel and railroad men throughout the country, having been connected with railroad sales almost continually since 1912, when he joined the Railroad Supply Company, at New York. In 1917, he left that company to join the army; he returned from the war in 1919 and became assistant to the vice-president. In 1930, he was appointed vice-president of the Railroad Materials Corporation, remaining in that position until joining the Youngstown Sheet & Tube Company.

THE HEYWOOD-WAKEFIELD COMPANY, Boston, Mass., has purchased the complete physical assets of the car seat business of the Hale & Kilburn Company, Philadelphia, Pa. Production of the latter company's seats and chairs will in the future be combined with the Heywood-Wakefield car seat activities at its Gardner, Mass., plant and at its general office in Boston, Mass. Walter M. Swope, formerly general manager of sales of Hale & Kilburn, represents the enlarged Heywood-Wakefield car seat interests, with headquarters at Philadelphia. Alfred B. Bell, formerly chief engineer in charge of seat design and engineering of the Hale & Kilburn Company, will become associated in the same capacity with the Heywood-Wakefield Company at the Gardner plant, as also will Otto G. Wolf, formerly chief estimator of Hale & Kilburn, with many former members of the Hale & Kilburn staff. Complete and prompt service on all Hale & Kilburn seat assemblies and parts will be maintained by the Heywood-Wakefield Company. The Hale & Kilburn Company's tools, dies, patterns and equipment are now in course of installation in the Heywood-Wakefield plant.

Obituary

B. F. MOORE, who retired as assistant to the vice-president of the Illinois Steel Company, Chicago, in 1932, died in Evanston, Ill., on May 25 following a paralytic stroke.

GEORGE C. MILLER, for about 10 years previous to 1919 vice-president of the Galena Signal Oil Company, now the Galena Oil Corporation, died on May 29 at his home in Miller Park, Franklin, Pa., at the age of 76 years.

CHARLES E. HALE, who died at Philadelphia, Pa., on April 16, was born at Elkhart, Ill., on April 21, 1879. Later he went to Chicago where he graduated from the grade schools. He then entered the Michigan Military Academy, from which he was graduated in 1899. In 1916 he entered the railway supply business with the



Charles E. Hale

Duff Manufacturing Company, and in 1919 became connected with the Baldwin Locomotive Works. From 1923 to 1929 he was manager of the Baldwin office at Pittsburgh, Pa., and was later located at Chicago. In 1932 Mr. Hale returned to the home office in Philadelphia where he was in active service until a few weeks before his death.

WILLIAM ELLIS COREY, who was from August, 1903, to January, 1911, president of the United States Steel Corporation, died on May 11 at his home in New York at the age of 68 years. Mr. Corey was a director of a number of industrial organizations, including the Baldwin Locomotive Works and the Vanadium Corporation of America. He was a member of the American Iron & Steel Institute, Iron & Steel Institute of Great Britain and American Institute of Mining Engineers.

OLIVER HARRY NEAL, eastern representative [illegible] New York City for the Union Asbestos & Rubber Company and the Equipment Specialties Company, died at Tucson, Ariz., on April 15, after a long illness. Mr. Neal was born at Baltimore, Md., on October 10, 1889. He served with the Baltimore & Ohio from January 9, 1907, to April 23, 1913, in capacities of machinist apprentice, machinist helper, machinist and fuel inspector. He resigned from that service and entered the employ of the Locomotive Lubricator Company, Chicago. On January 1, 1925, he entered service of the Union Asbestos & Rubber Company and Equipment Specialties Company.

RAYMOND BOISELLE, representative of the Westinghouse Air Brake Company at New York, died on May 22 in a hospital at Reading, Pa., at the age of 43, from injuries received in an automobile accident on May 11. Mr. Boiselle was born on May 18, 1891, at Hoisington, Kan. His



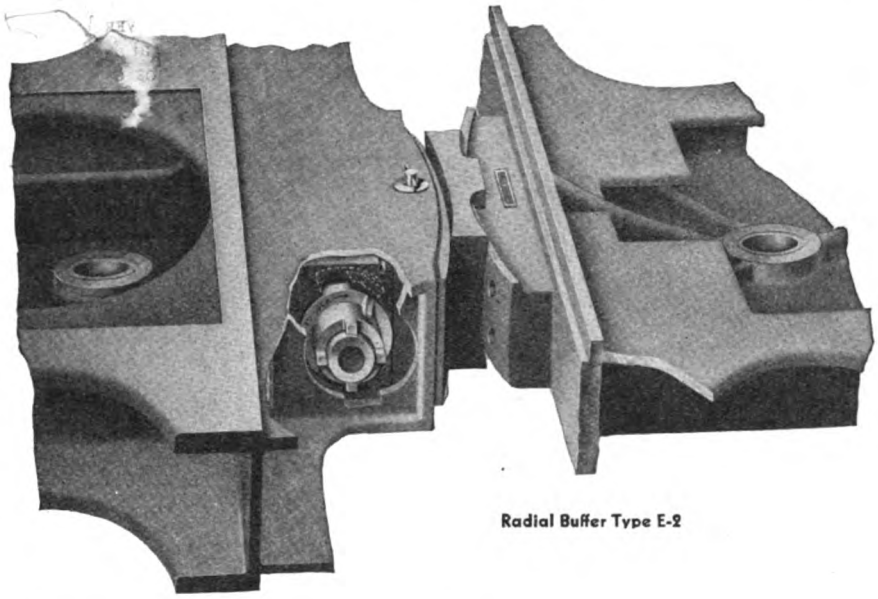
Raymond Boiselle

mechanical engineering education was received at the University of Illinois and his early practical experience with the Missouri Pacific, the Atchison, Topeka & Santa Fe, and the Chicago, Rock Island & Pacific. He entered the service of the Westinghouse Air Brake Company in 1912 and was employed in the test department until 1917. During the World War he served overseas as first lieutenant and captain, Aerial Armament Division. After the armistice he was appointed mechanical expert in the southwestern district of the Westinghouse Air Brake Company, with headquarters at St. Louis, Mo. He became representative in the Pittsburgh district in 1923 and four years later was appointed representative of the Boston territory, with headquarters at Boston, Mass. He became steam road representative at New York in 1929.

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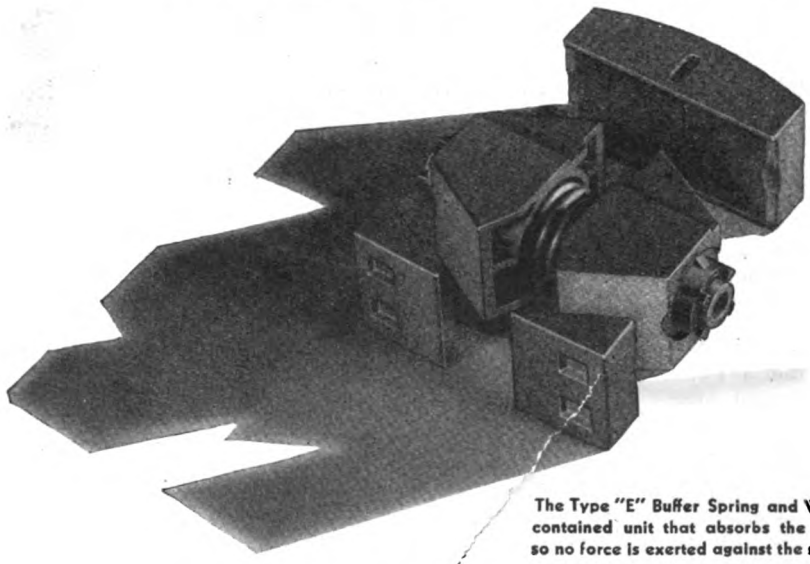
200,000 MILES

WITHOUT APPRECIABLE WEAR



Radial Buffer Type E-2

For over 200,000 miles a Franklin Type "E" Radial Buffer has been in service on a large Eastern Railroad. It is still as effective as the day it was applied; wear has been negligible. « The transverse, spring controlled, frictional resistance of this design has stopped synchronized oscillation between engine and tender and has made a fine riding locomotive as well as prolonging the life of buffer springs and wearing surfaces.



The Type "E" Buffer Spring and Wedges form a self-contained unit that absorbs the stress within itself so no force is exerted against the sides of the pocket.

Because material and tolerances are just right for the job, genuine Franklin repair parts give maximum service life.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

Personal Mention

General

D. J. MULLEN, superintendent of motive power of the Cleveland, Cincinnati, Chicago & St Louis, has been appointed superintendent of equipment, with jurisdiction over motive power and rolling stock departments (other than shop operation) and headquarters at Indianapolis, Ind.

F. K. MURPHY, assistant superintendent of motive power of the Cleveland, Cincinnati, Chicago & St Louis, has been appointed assistant superintendent of equipment, with jurisdiction over the motive power and rolling stock departments (other than shop operations) and headquarters at Indianapolis, Ind.

DAVID LEE FORSYTHE, general road foreman of equipment of the St. Louis-San Francisco, has been retired, after 46 years of continuous service. Mr. Forsythe was born on March 27, 1864, at Little Rock, Ark. He attended high school at Little



D. L. Forsythe

Rock and in October, 1882, became a fireman on the St. Louis, Iron Mountain & Southern. He entered the service of the Kansas City, Memphis & Birmingham (now a part of the St. Louis-San Francisco) on November 20, 1887, as a fireman, on February 20, 1889, being promoted to the position of engineman. He was appointed road foreman of equipment in July, 1906; assistant master mechanic in September, 1911; master mechanic, July, 1913; road foreman of equipment, November, 1915; inspector of train and station service, December, 1916; road foreman of equipment, Southern Division, April 1, 1918, and general road foreman of equipment, July, 1923. Since 1926 he has supervised several tests in which locomotives were run 2,940, 7,350, and 9,743 miles, respectively, without fires being knocked. Mr. Forsythe is at the present time third vice-president of the Traveling Engineers Association and vice-president of the Frisco Veterans' Association.

R. N. MCKITTERICK, enginehouse foreman of the Atchison, Topeka & Santa Fe at Emporia, Kan., has been promoted to the position of fuel supervisor, with headquarters at Amarillo, Tex.

Master Mechanics and Road Foremen

F. D. WARNER, master mechanic of the Canadian Pacific at Calgary, Alta., has been transferred to Saskatoon, Sask.

J. P. KELLY, master mechanic of the Canadian Pacific at Saskatoon, Sask., has been transferred to Calgary, Alta.

RICHARD SMITH has been appointed master mechanic of the Missouri Pacific at Memphis, Tenn., with jurisdiction over the Union Railway of Memphis and the Memphis division.

E. A. SCHRANK, general foreman in the locomotive department of the Chicago, Burlington & Quincy at Galesburg, Ill., has been promoted to the position of master mechanic of the McCook division, with headquarters at McCook, Neb.

F. R. BUTTS, assistant master mechanic of the St. Joseph division of the Chicago, Burlington & Quincy at St. Joseph, Mo., has been appointed master mechanic of this division and the position of assistant master mechanic has been abolished.

E. R. HANNA, master mechanic of the Missouri Pacific at North Little Rock, Ark., has been relieved of jurisdiction over the Union Railway and the Memphis division, but will continue as master mechanic of the Arkansas division.

Shop and Enginehouse

H. MODAFF, acting superintendent of shops on the Chicago, Burlington & Quincy at West Burlington, Iowa, has been appointed superintendent of shops at that point, succeeding W F. Ackerman, deceased.

Purchasing and Stores

A. H. LILLENGREN, acting purchasing agent of the Great Northern, with headquarters at St. Paul, Minn., has been appointed purchasing agent at that point.

C. E. WALSH, purchasing agent of the Pennsylvania, with headquarters at Philadelphia, Pa., has been promoted to the position of general purchasing agent. Mr. Walsh was born at Uhrichsville, Ohio, on September 20, 1882. He started his railway career as storeroom clerk for the Pittsburgh, Cincinnati, Chicago & St. Louis (now part of P. R. R.) in May, 1899. Subsequently, from November, 1901, to January, 1913, he served with the Pennsylvania in various clerical positions in the office of the purchasing agent, as assistant chief clerk to the purchasing agent, and as chief clerk in the same department. In June, 1914, he was appointed assistant purchasing agent at Pittsburgh, Pa. He was placed in charge of the purchasing department of the Pennsylvania, Lines West of Pittsburgh, from February, 1918, until March, 1919, during the absence of the purchasing agent. In March, 1920, he became asssitant purchasing agent of the Central region, with headquarters in Pittsburgh, and in January, 1924, was transferred in the same capacity to Philadelphia. Mr. Walsh was promoted to the position of purchasing agent of the Pennsylvania in January, 1927, serving similarly also on the Long Island and the Baltimore & Eastern.

Obituary

ROBERT J. TURNBULL, assistant to general superintendent of motive power of the Atlantic Coast Line at Wilmington, N. C., died at his home in Wilmington, on April 28.

JOHN W. SENGER, assistant superintendent of equipment of the New York Central, with headquarters in Cleveland, Ohio, died at his home in that city on May 20. Mr. Senger was 64 years of age. He entered the service of the New York Central on September 15, 1883, as a messenger at Cleveland, Ohio. He later served as yard foreman, general foreman and supervisor of materials for the same road and as master car builder at various points. In March, 1920, he was appointed superintendent of rolling stock, Lines West of Buffalo. In November, 1931, Mr. Senger's jurisdiction was extended to include also the Ohio Central lines. He served in this latter position until May 1 of this year, at which time the mechanical department of



J. W. Senger

the New York Central was re-organized and Mr. Senger became assistant superintendent of equipment at Cleveland.

H. H. PARKER, master mechanic of the Norfolk-Portsmouth Belt Line, died at Portsmouth, Va, on May 11 after an illness of several months. Mr. Parker, in 1931, aroused by the great harm done to the railroads by unregulated and undertaxed bus and truck competition, began in his home city, Portsmouth, Va., to expound his views to railroad employees and, as a consequence, a so-called Railroad Employees and Taxpayers Association was organized at that point with Mr. Parker as its president. The movement became state-wide in Virginia and thence spread to many other states. Mr. Parker was born in Wilmington, N. C., and prior to his service with the Norfolk-Portsmouth Belt Line, was in the employ of the mechanical department of the Seaboard Air Line.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

July, 1934

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices, 30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: **Terminal Tower**
Washington: **832 National Press Bldg.**
San Francisco: **58 Main St.**

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Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States and possessions: 1 year, $3; 2 years, $5. Canada, including duty: 1 year, $3.50; 2 years, $6. Foreign countries: 1 year, $4; 2 years, $7.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.

NRA U.S. CODE GRAPHIC ARTS INDUSTRY

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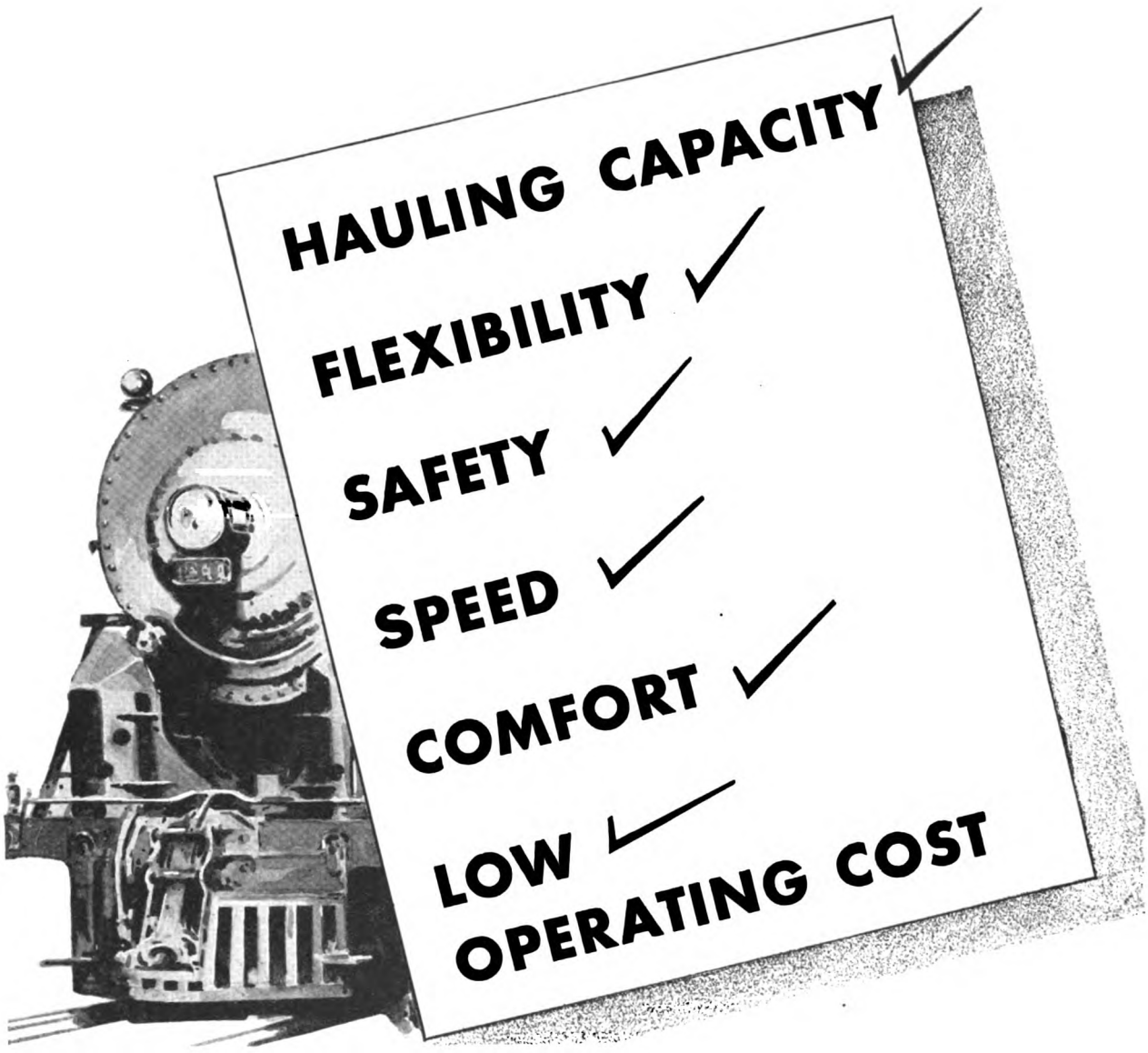
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July - 1934

Suggests Revival of Mechanical Conventions*

Executive tells Editor that much of the progress in the railway field has been due to the activities of these organizations in the past

IT is now four years since the Mechanical Division of the American Railway Association has held a convention. It is not intended to infer that the Division has not been active during this period. Its committees have functioned more or less steadily. It has continued to improve its standards and recommended practices and can take real pride in some of the constructive accomplishments during this period. The standard box car and the adoption of the "AB" freight brake equipment can be numbered among these accomplishments, although naturally the inception and early development of these projects was started well before the last convention in 1930.

The railroads have had to fight for their very lives during the depression, and the situation has not been made easier because of the competition of unregulated and, to a large extent, subsidized carriers, including those operating on the highways, waterways and airways. It has been necessary to cut expenses to the very minimum, and railway managements are not to be criticized for having reduced association activities, including the almost entire elimination of conventions. True, the General Committee of the Mechanical Division has been active, and each year, at about the time of the regular convention, has held a meeting, to which have been invited the committee chairmen. Most of the other mechanical associations have entirely discontinued their meetings.

Has the time come when the mechanical associations should resume their former activities, or have conditions changed so radically in recent years that conventions should be done away with and the work of the associations be conducted on a different basis?

What an Executive Thinks

With these questions in mind, we approached a Railroad Executive of long and successful experience. He has made an enviable reputation because of his ability in getting things done and because he has never hesitated to take the initiative along new and original lines. He has made a good job of selecting department heads and in maintaining a high morale in his organization. He has been active in different associations in the railway field and, searching the records, one finds his name among the organizers of several such groups.

"Is it not high time that the mechanical associations resume their regular programs and annual conventions?" I asked.

"Yes, I believe it is," replied the Executive. "As you know, I have always been interested in the work of the various railway associations, because of the constructive and worth-while things they have accomplished. They are responsible to a large extent, in my opinion, for the remarkable progress which has been made by the railroads over the years. It will be a serious mistake if we allow these organizations to disintegrate or to lie dormant any longer than is absolutely necessary."

"Why were the conventions discontinued?" I asked.

"For very good reasons," replied the Executive. "In the emergency through which we have passed, railway managements have been put to their very wits' ends to keep down expenses and survive. Because of all of the uncertainties through which we have passed and the fact that our organizations have been reduced to a skeleton, it has been necessary to eliminate many worth-while activities, and among these have been the association conventions."

Radical Improvements Require Critical Attention

"Many radical changes have taken place in the last few years," I said. "Repair shops have operated on a light schedule or have been closed down part of the time; business has been so light that it could readily be handled with a small part of the equipment. Meanwhile, there has gone forward a steady centralization of repairs and maintenance, permanently closing out a considerable number of the smaller shops and repair plants. Lengthening of locomotive runs has eliminated many division points. Since general business has picked up, however, the traffic officers of our railroads have been eager to find ways and means of regaining traffic which has been

* Twelfth of a series of interviews with men outside the mechanical department, commenting in a constructive way upon the possibilities of that department.

taken away by other types of carriers. This calls for new methods and new types of equipment. As an example, pick-up and storedoor delivery is being installed in many places; great numbers of passenger trains are being equipped with air conditioning apparatus; high speed, streamlined trains are being introduced, and the Diesel engine is receiving much attention. Will such changes as these have any effect upon the situation?"

"Decidedly," replied the Executive. "In my opinion, and in the light of these changes, it is absolutely necessary for the various associations to speed up their activities and plan on holding real conventions. I know perfectly well that some of these conventions have been criticized in the past, because of certain abuses which I need not mention. While we must admit that sometimes there have been improprieties, yet, in the last analysis, most of the men who have attended the conventions have taken the task seriously, have worked hard at the meetings, and, as I have already said, have made these conventions the basis of much of the real progress in the railway field.

"It is high time," he went on, "that, for technical reasons, the mechanical department officers, for instance, should hold their regular meetings in order to compare notes with a view to wisely directing the railroads in the selection, maintenance and operation of equipment and facilities made imperative by changing traffic and operating requirements. You must remember that railroad officers and supervisors have been hard hit by the conditions through which they have had to pass, and many of them have become badly discouraged. Coming together in large groups to discuss the changes which have taken place and how best to meet them will do much to encourage these men, put new life into them and start rebuilding the morale, which, naturally, has sagged badly in these recent years."

Changed Personnel a Factor

"Is it not true," I ventured, "that the last four years have seen many changes in personnel, and does not this factor enter into the problem?"

"It surely does," replied the Executive, "and it is all the more reason why, as quickly as possible, the meetings of the organizations should be resumed. Many of the older men have dropped out, and as business has picked up, and will pick up more and more in the days to come, new faces will come into the picture. These new officers and supervisors need all the coaching possible, if they are to make good on their new jobs. I cannot too strongly emphasize this, because it does seem to me that changing conditions in the transportation field are going to require better trained and bigger men than ever before. Working on committees, coming in contact with their fellows on other railroad systems, and meeting in conventions, is an excellent means of assisting them to measure up to their new responsibilities.

"Then, too," the Executive added, "I am deeply concerned in the development of the younger men in our organization. Many of them have been eliminated in these recent years. The experiences through which those who have remained in service have passed have not been very inspiring, although, if they come through the ordeal safely, it may help to make stronger men of them. The railroads must be wide awake to incorporate new and younger blood into their ranks. As I look back over my years of service, it seems to me that in my younger days the inspiration and help I received from attendance at conventions and technical gatherings was no small factor in my progress and advancement. I believe we must deliberately tackle this problem of encouraging and assisting the younger men, and I firmly believe that association activities and conventions will be exceedingly helpful in this respect."

Federal Co-ordinator's Activities

"What effect, if any, will the activities of the Federal Co-ordinator of Transportation have upon the program of the various railroad associations?"

"I am glad you asked that question," replied the Executive. "Up to this time, at least, Mr. Eastman's department has functioned largely as a great research bureau. It has gathered together, at heavy expense to the railroads, a vast amount of statistics. The value of these will be lost unless they are thoroughly digested and intelligent action taken on the basis of the pertinent facts and trends which are disclosed. The best way to do this, as I see it, is to have the various associations concerned tackle these problems with determination and aggressiveness—and with a view to reaching sound conclusions as early as possible.

"This seems to me to be the intention of the Co-ordinator, if I interpret his program properly," continued the Executive. "Let me read, for instance, a few sentences from his letter to the presidents of the Class I railroads, dated June 9, and relating to the report on the economic life of steam locomotives and the cost of repairs. This, you will recall, was the second section of the steam locomotive study which has been going forward under Mr. Eastman's Section of Car Pooling:

'Admittedly, the locomotive problem is a complicated one. Unfortunately, many of the factors essential to an adequate solution of the problem are today unknown. Considered solely from the financial standpoint, the magnitude of the amount involved justifies the most thorough research in the development of facts upon which correct assumptions may be based and efficient practices applied. * * * * I am impressed, however, with the need, in the solution of this and other operating problems, for the substitution of factual analyses and scientific study for rule-of-thumb methods and arbitrary personal preferences in the determination of questions which vitally involve the efficiency and the solvency of the railroads.'

"This," continued the Executive, "is only one of several tremendously big problems of primary concern to the mechanical department to which the Co-ordinator's organization has been giving special attention. This, by the way, is not surprising in light of the fact that the expenditures of the mechanical department are so large a factor in the total cost of railway operation. Surely this challenge affords ample justification for putting more life and energy into our associations and conventions."

Looking Forward

"Do you look forward to any great increase in railroad activities in the coming months?" I asked.

"As you know," replied the Executive, "I have always hesitated to make prophecies as to what was likely to happen in the future. On the other hand, I am an optimist over this great country of ours, and there is no question in my mind but what business is going to come back and that the railroads will enjoy continuing prosperity, with, of course, occasional setbacks. Without doubt business will continue to improve, but whether progress will be fast or slow in the months immediately ahead is, in my opinion, impossible to predict.

"On the other hand," he continued, "I have always been guided by the old adage, 'Dig the well before you become thirsty.' In my opinion the time is not far distant when the railroads will find it necessary to speed up their activities. This does not necessarily mean that the railroad personnel as a whole will be greatly increased, but undoubtedly the technical departments will

have to enlarge their programs and add to their forces. It will be just too bad if we delay so long in putting our house in order that we will find ourselves thirsty and have no source from which to satisfy that thirst.

"I believe," concluded the Executive, "that it is not too soon to get busy on plans for speeding up the activities of the various associations in the mechanical as well as in other departments of the railroad, and to schedule conventions with a view to getting well-attended meetings of representative members. I do not maintain that we must necessarily hold the same kind of meetings as we have always held. This is something that may well require careful consideration and study. It is essential, however, that we adopt programs that will serve to help railroad officers and supervisors in a very constructive way, and to inspire them to greater efforts. 'Break the spirit of a man, and the body is dead.' Let us do everything we can to build up and encourage the morale of our organizations and there will be no question about the future progress and success of the railroads."

Mechanical Division Committees Report at Chicago Meeting

Important work covered in 17 committee reports many of which indicate extensive engineering research regarding new materials and methods

THAT no efforts are being spared to improve railroad service and operation is indicated in the reports of the various standing committees of the American Railway Association, Mechanical Division, which were presented to the General Committee at a meeting held at Chicago, June 27 and 28. Several of the reports contain data and information of unusual interest which have been collected as the result of extensive engineering research and service tests and which will undoubtedly have an important bearing on the performance and costs of railroad service.

Typical examples of this constructive work in the interests of the general public and the railroads of the future are afforded by the report of the Mechanical Division, Committee on Research. Under the supervision of Director H. A. Johnson, this committee has given attention to a total of 19 special assignments, making extensive surveys, studies, or tests in connection with such subjects as: Standard method of rating and inspecting locomotive coal; sweating of steel car roofs; streamlining of high-speed passenger trains; air-conditioning of passenger cars; possible savings in operating cost by the use of lighter freight cars; economics of freight-car dimensions and capacities; railway refrigeration service; automatic train-line connectors, etc. The Committee on Car Construction has made exhaustive technical stress and impact tests of the A.R.A. standard box car with highly satisfactory results. It has also tested and proposes to make further tests of improved trucks and spring snubbing devices designed to promote easy riding in freight cars at modern high operating speeds and thus reduce lading and equipment damage. Other committees have perfected locomotive details; continued research in draft gears; specified maintenance requirements for the new AB freight-car brake; developed improved car-wheel specifications; studied the important problem of lubricating railway equipment; tested and specified more efficient loading methods; analyzed the requirements for more safe and satisfactory tank-car service; and conducted tests in many other pertinent subjects.

The two-day meeting of the General Committee was presided over by Chairman E. B. Hall, general superin-



E. B. Hall, Chairman



O. A. Garber, Vice-Chairman



V. R. Hawthorne, Secretary

tendent of motive power and machinery, Chicago & North Western, and Vice-Chairman O. A. Garber, chief mechanical officer, Missouri Pacific, the general order of business being followed in accordance with a docket prepared by Secretary V. R. Hawthorne. As there is no provision for an election of officers of the Mechanical Division, except at a regular annual convention, the terms of Mr. Hall as chairman and Mr. Garber as vice-chairman were extended until June, 1935. Six members of the General Committee whose terms expired in June, 1934, were also re-elected to serve until June, 1936, these members being as follows: J. W. Burnett, general superintendent of motive power and machinery, Union Pacific system; F. W. Hankins, chief of motive power, Pennsylvania; R. G. Henley, superintendent of motive power, Norfolk & Western; F. R. Mays, general superintendent of motive power, Illinois Central; John Purcell, assistant to the vice-president, Atchison, Topeka & Santa Fe; and Silas Zwight, general mechanical superintendent, Northern Pacific. Vacancies in the membership of the General Committee due to resignations of C. E. Chambers and A. R. Ayers were not filled.

Full Membership Meeting in 1935

One of the most significant actions taken by the General Committee was its unanimous vote to hold a full membership meeting in June, 1935, the decision regarding the question of exhibits to be made later, contingent upon business conditions. This action was taken to permit the representatives of all member roads who have not had an opportunity to be present at a regular annual meeting of the A.R.A. Mechanical Division since 1931 to participate in the proceedings and help formulate the action taken as well as to pass on it subsequently by letter ballot. The thought was also advanced that with a lapse of four years since the last regular annual meeting a sufficiently large number of new appliances, tools, equipment specialties, etc., will have been developed to justify the special study and consideration of mechanical department officers.

Abstracts of the various reports appear in the following pages with the exception of the report of the Joint Committee on Utilization of Locomotives and Conservation of Fuel. This is merely a progress report including data to indicate trends and factors by years for Class I roads as a whole.

Report on Automotive Rolling Stock

Research and development activities as applied to automotive rolling stock equipment for railway service naturally falls under two subheads or divisions.

First—The motive power unit consisting of the prime mover, transmission, control, etc.

Second—The vehicle consisting of wheel and truck mechanism, frame, body, etc.

In general it seems that in all probability there will be eventually three service classes of automotive rolling stock.

Class 1. All-railway service.
Class 2. All-highway service.
Class 3. Dual, highway and railway service.

It is now becoming generally understood that whenever rail motor equipment is not used for carrying cargo or passengers that it should be designated as a locomotive. It is recommended that a more suitable term be developed to facilitate the classification of all types and forms of motorized rail equipment including all automotive types, that is, all types of motive power other than steam or electric.

Highway service is divided between passenger and freight units while the eventually probable dual or combination rail and highway service unit will, it seems, be limited to cargo carrying.

The trend of the times indicates that railway rolling stock may be eventually divided into two general classes, the present conventional type which might well be called primary equipment and a lighter type that might equally well be called secondary equipment. The two general types of equipment will be subdivided as often as necessary to classify correctly the various forms of subtypes developed for freight and passenger service, including co-ordinated or dual rail-highway service.

Realizing that the development and use of internal-combustion engines in railway service is of necessity in an unsettled state it was thought advisable to discuss the subject in the following sequence:

The gasoline engine such as is available today is already faced with supersedence by the Diesel engine in the railway motive power field and probably in the heavy-duty highway motive power field.

Diesel Engines in Railway Service

During the past few years some important improvements have been effected in marine and stationary Diesel engines which have resulted in obtaining much greater net over-all efficiency.

After many years of seemingly more or less futile effort designers have arrived at an understanding of the two-cycle principle and of many supporting minor factors which now makes possible the building of engines that will meet the economic requirements of Diesel engines in the railway and heavy-duty highway motive power fields. References in this report will therefore, be limited to these fields, both being included largely for the reason that the recent development of such Diesel equipment makes the coordination of these two methods of transport, rail and highway, imperative.

That some of the foremost Diesel designers have solved the basic problems involved in the two-cycle engine makes possible engines having characteristics essential to these two motive power fields: (a) Engines with the necessary comparative low cost per unit of horsepower output; (b) Engines with the necessary comparative light weight per unit of horsepower output; (c) Engines having simplicity, ruggedness, reliability, long life, low operating and maintenance costs, requiring few terminal chores, having the ability to accumulate high mileage before necessity for shopping, and possessing the necessary characteristics for speed, flexibility, and rapid acceleration.

Rail motive power units equipped with such engines may be so designed as to make them extremely easy on track at high train speeds. Also such units would possess sufficient flexibility to make possible their use in more than one class of service. In this connection the infrequent fueling factor is of considerable relative importance.

Simultaneously with the improvements made in the engines themselves there has been developed a better understanding of the requirements of Diesel fuels and lubricants by some of the larger oil companies. It has been proven that much needed superior lubricants to meet the requirements of modern conditions can now be produced, and that Diesel fuel can be economically produced and distributed. These are essential factors in the dieselization of rail and heavy-duty highway motive power.

In the rail motive power field electric transmission and control has been developed to the point of much improved reliability, ruggedness, and simplicity. However, the manufacturers should be encouraged to make improvements which will reduce weight and costs. Such research as has already been made gives promise that such improvements are within the realm of probability, especially as regards voltage and current ranges, values and characteristics.

In the field of heavy-duty highway motive power for dual or co-ordinated rail service the manufacturers should be encouraged in the development of improved mechanical transmissions having a flexibility that will permit a more efficient operation of the power vehicle under varying load, grade, speed and traffic conditions.

The adaptability of the internal combustion engine to light weight, streamlined, high speed, articulated passenger motor trains has been exemplified in the two trains recently completed by the Union Pacific and Burlington. Other trains of a general similar design are being built and evidence of their fitness will soon be available. There are also being built some light weight, streamlined passenger trains of more conventional design for comparatively high speed, with conventional type couplers etc., some of which will be hauled by streamlined Diesel-electric locomotive and some by streamlined steam locomotives.

The Baltimore and Ohio is designing two such trains, one to be hauled by a Diesel-electric and one by a steam locomotive, both streamlined.

The Milwaukee has built and is now building some light weight passenger carrying cars for operation in steam train service.

Some tentative designs have been made for a streamlined,

comparatively light weight train, each car having a four wheel truck located near each end, the cars having no end platform, entrances being at the center. The forward car carries mail and express, also contains two 100 Kw. Diesel-electric power plants furnishing current for heating, air conditioning, lighting, cooking, refrigerators, etc.

The motive power unit for hauling the trains to be either streamlined Diesel-electrics or streamlined steam locomotives whose only connection with the trailing cars would be the draft couplers and air hose for brakes and signal. In this type of train some weight sacrifice and a surrender of the advantages of articulation would have to be made to obtain greater flexibility of operation as regards setting out or picking up cars, other than the forward car, for service or in case of individual car trouble. This method of design also makes possible the use of any available locomotives in an emergency, such as might be occasioned by a failure of the regular motive power unit.

The Union Pacific train built of aluminum and the Burlington train built of "shotwelded" stainless steel will, in a comparatively short time, make available some comparative data relative to the two classes of material and the methods of construction involved.

A few self-propelled single-car units have been built incorporating streamlining and light weight factors in an endeavor to obtain speed characteristics, etc. most of them driven by internal combustion engines. In one case, however, a high-pressure condensing steam unit was utilized. It is expected that some figures relative to this equipment will be available during the coming year.

The Budd Company has built several gas-electric, light-weight trains with rubber-tired wheels, the largest being for the Texas and Pacific.

Automatic steam heating and air conditioning equipment for motorized trains have been sufficiently demonstrated to indicate that no serious difficulties will be encountered in the design, construction and operation of suitable air conditioning equipment for such trains, including the three factors—heating, cooling and cleaning of the conditioned air, etc. However, the exercise of considerable discretion and caution is advisable in choosing apparatus.

In Europe the development of a rolling jig has proven beneficial in the construction of cars by the electric welding process, this method of construction being used in the building of high speed Diesel-electric trains for the Netherland Railways.

The reports from Germany indicate that the Federal Railways, in an endeavor to meet the increasing competition of the aeroplane and private truck operators, are planning the trial during the next few years, of self-propelled motor cars and trucks for passenger and freight traffic.

The economic introduction of the Diesel-electric locomotive to switching service has made considerable strides. It is felt by some that the two-cycle engine will do much to improve the Diesel-electric type switcher, especially where fast work is desirable and necessary such as in kicking cars, due to the doubling of the power impulses per time period, etc. Many also feel that the two-cycle engine together with some of the other recent developments will make possible the use of Diesel-electric power units for long distance, high speed freight trains and possibly in some passenger service, facilitating the utilization of our present trailing equipment. The use of large Diesel-electrics for developing long distance high speed freight train service seems to be worthy of consideration.

Coordinated Rail and Highway Service

Some effort has been made in an endeavor to develop a coordinated rail and highway freight service by using trucks to pick up and deliver freight at terminals, moving the trucks on railway cars operated in regular trains between terminals. Not enough experience has been had to determine what the ultimate result of such an arrangement may be.

Not a little effort has been expended in an endeavor to physically coordinate rail and highway service by developing a cargo carrying unit of a dual nature, which could be used as a trailer both on the rails and on the highway and also adapted to movement in railway cars operated in regular trains. The efforts have practically all been made with the idea of utilizing the dual vehicle, generally as a trailer-tractor drawn for the gathering and distributing short haul on the highway to and from the rail highway terminal and intermediate terminals, and as a car unit in a railway secondary equipment type of train on the rails for the shorter rail hauls, and in primary equipment type cars operated in regular train service for the longer rail hauls.

The report was signed by E. Wanamaker (chairman), electrical engineer, C.R.I. & P.; H. F. Finnemore, assistant electrical engineer, Can. Nat'l; B. N. Lewis, mechanical superintendent, M. St.P. & S.S.M.; F. K. Fildes, general foreman, Pennsylvania, and J. R. Jackson, engineer tests, Mo. Pac.

Action.—The report was accepted.

Report on Brakes And Brake Equipment

The following report of the Brake Committee is submitted for consideration:

Retaining Valves

For several years a number of roads have complained of difficulty with brakes failing to release on account of present standard A.R.A. retaining valves and pipe connections being stopped up by mud-bees or wasps building their nests therein. This trouble seems to be chronic with cars that stand idle, such as stored cars, etc.

The Brake Committee has suggested the application of several special brass plugs having various shaped openings, to the retaining valve exhaust port, in order to exclude the entrance of such bees and wasps. They have also tried application of creosote to the retaining valve openings and small strainer arrangements, none of which have proven entirely satisfactory.

About a year ago the air brake companies designed a new type of cap having a multiplicity of small slotted openings to exclude the entrance into the retaining valve exhaust of various kinds of troublesome insects, and we suggested a liberal application of this new design.

We have had no complaints of the new caps being ineffective and upon examination of some of them which had been in service for eight months, disclosed that the interior of the caps were quite clean, indicating that the device will run throughout the ordinary cleaning period for brake equipment without collecting sufficient dirt or scale to restrict the exhaust opening.

In view of the results obtained and the possible delay and wheel damage due to retaining valves and pipes being stopped up without the use of some such device, we recommend adopting as recommended practice, the "Wasp Excluder" for the protection of the exhaust port of the A.R.A. standard retaining valve for eight-inch and ten-inch brake equipment.

Condemning Gages For K Triple Valves

Attention has been called to the fact that no standard instructions have been prepared for insertion in the A.R.A. Manual to govern the use of K triple valve wear limit gages. In order to define the use of gages shown in Circular DV-800 we recommend incorporating in the Manual of Standard and Recommended Practice the following instructions in connection with these gages: [Instructions governing the use of the 12 gages are omitted in this abstract.—EDITOR]

Graduating Springs Freight Triple Valves

In report for 1930 we recommended a change in graduating springs from Pc. No. 1057 to Pc. No. 18286 for freight triple valve in order to eliminate as far as possible, undesired emergency applications. This recommendation was concurred in and we assumed that roads generally would substitute the recommended spring for the old type in service. It seems, however, that such substitutions are made only in cases where it is necessary to replace the older type springs. The change from the former to the new type spring is greatly delayed on this account.

The experience of those roads which have resorted to the general use of the new spring has been that undesired emergency action during service operation has been practically eliminated, but due to the general interchange of equipment they are not able to derive full benefit from the new spring on account of the large number of cars yet remaining to be equipped with these new springs.

We have strongly urged upon the carriers, the desirability of changing these springs as rapidly as possible, and in order to provide for the general application of the new spring to triple valves not so equipped, we recommend that the Arbitration Committee establish an effective date after which the K triple valve must be so equipped, adding to the requirements of Rule 60 a similar requirement to that appearing in Pc. Rule 7 referring to the L-2 Triple valve.

If this recommendation is adopted, we would also recommend incorporating in the Manual of Standard and Recommended Practice a drawing showing a device for checking the capacity of the 18286 graduating spring, the use being optional.

Locking Type Cocks

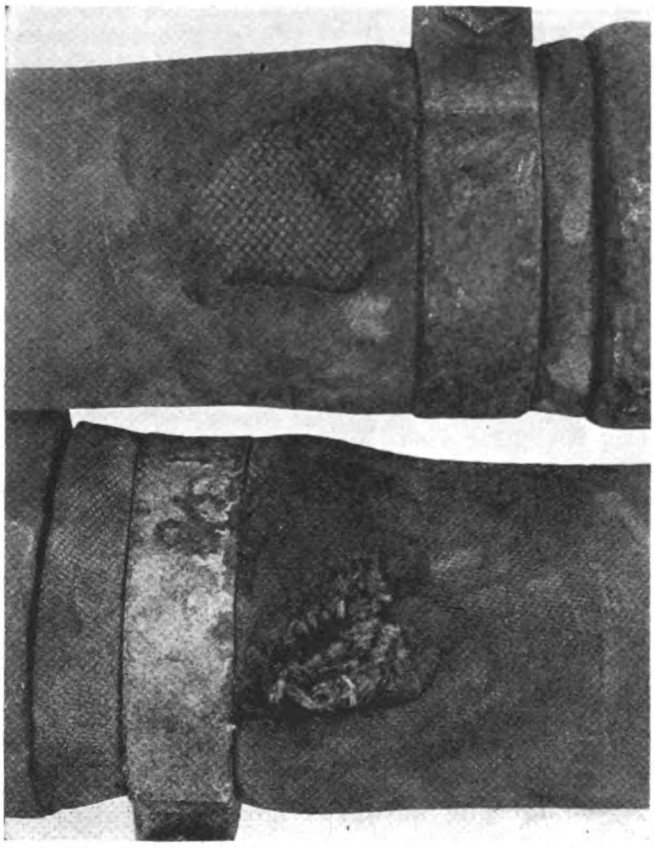
At present there are no requirements in effect to insure the proper locking of the standard brake pipe angle cock in its open or closed position, nor to prevent the angle cock or branch pipe cut-out cock handle being turned to an improper position when the operating parts are worn considerably. In order to provide for the proper functioning of these devices we recommend adopting as standard the requirements shown in the drawing. "Minimum

Permissible Engagement of Locking Lugs on Angle and Cut-out Cocks." [Minimum Contact length shown is 3/32 in.—EDITOR]

This requirement to govern repairs to these devices and establish a condemning limit when excessive wear of parts exist.

Auxiliary Reservoir Release Rods

A member road has recently suggested the advisability of redesigning the present release valve rod for operating the auxiliary reservoir release valve on freight equipment, basing their request upon the fact that they found a number of such release rods missing. Their proposal contemplated enlarging the hole in the release valve handle and rod to 7/16 in. and using a 3/8-in. cotter key or reducing the end of the rod to 3/8 in. and bending it through the release valve handle.



Defective hose (below) which should be removed—hose (above) with hole in outer cover and fabric in good condition. This hose should not be removed until there is some indication of damage to the fabric

There is not sufficient depth to the jaw on the release valve handle to provide for the changes suggested, therefore, we canvassed the situation upon the roads represented by the committee and find the general opinion of car foremen is that if the release valve rod is properly made and applied there should be no complaint of missing rods. The rods should be applied with proper size cotter keys which is 1/4-in. and the cotter keys drawn up tight and properly spread.

These rods are found with holes as small as 1/8 in. and are attached with nails of various sizes or wire, and in many cases wherein holes are of proper size, 1/8-in. to 3/16-in. cotter keys, wire, nails, etc., are used to keep them in place.

We are of the opinion that if release valve rods are made and attached to the release valve as shown, there should be no complaint. [Drawing shows 9/32-in. holes, rod flattened to 5/16-in. thick and 1/4-in. cotter.—EDITOR]

Condemnation of Air Brake Hose

Considerable controversy has arisen regarding defective air brake hose removed in train yards. Such hose are commonly designated as porous or spongy, although they are not subjected to soap suds test to determine porosity. It is impractical to subject such hose to soap suds or other moisture tests and present rules do not provide for removing hose upon visual inspection of other defects.

In order to clarify this situation we are submitting as a matter of information, four illustrations bearing instructions in effect by a member road, regarding the removal of air hose in train yards and recommend to the Arbitration Committee the following proper terms covering defective air hose for which the car owner is responsible:

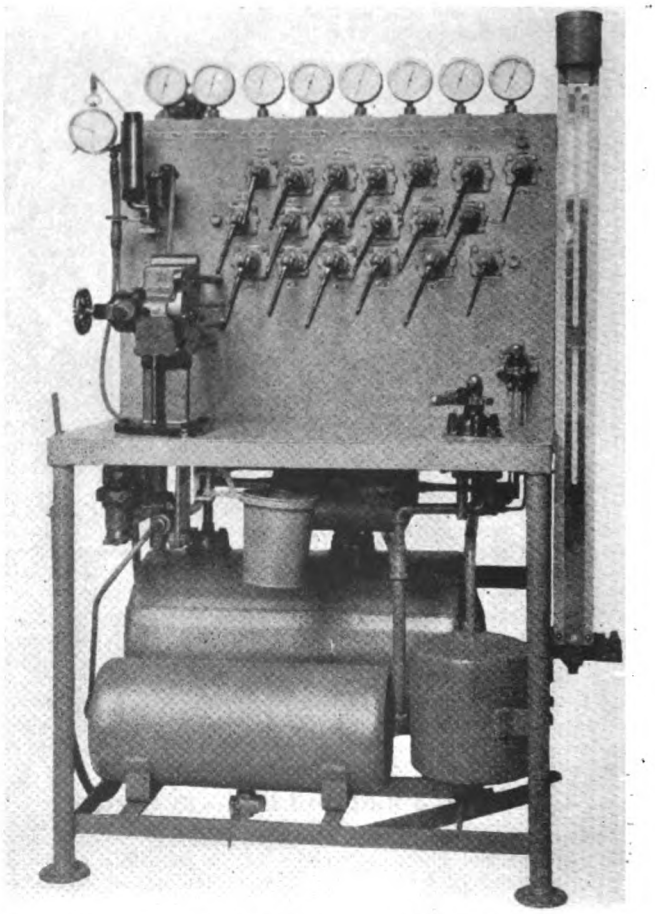
1. *Burst.*
2. *Damage* account abrasion which has removed outer covering and shows indication of damage or deterioration to first layer of duct.
3. *Cracks, longitudinal or spiral* which shows indication of damage or deterioration to first layer of duct.
4. *Soft spots* which indicate clearly that the fabric is broken down.
5. *Loose fittings* where end of the tube is 1/8 in. or more from the shoulder on either the nipple or coupling.
6. *Leakage* discernible without test.
7. *Spongy and porous* as determined by soap suds test, either on or off the car.

"AB" Freight Brakes

Since the introduction of an increasing number of "AB" brakes into service following the original 925 cars equipped by the Pennsylvania, there has been a growing demand for suitable instructions covering the cleaning, lubricating and testing of same.

In order to provide for the above we requested the air brake manufacturers to design a suitable test rack with test codes for testing the "AB" valve and in co-operation with them have developed instructions for the maintenance of this equipment.

In this connection we recommend submitting for adoption as recommended practice, the "AB" test rack shown and the Code of tests for testing "AB" Freight Brake Equipment. We also recommend submitting for adoption as recommended practice, the instructions under the heading "AB" Freight Brake Equipment, Cleaning, Lubricating and Testing. [Instructions for cleaning, lubricating and testing, and for operation of test rack, are omitted in abstract.—EDITOR]



Complete assembly of the new AB freight-car brake test rack

Standard Brake Beam Gages

When the No. 15 brake beam was adopted as standard last year, it was obvious that the existing gages suitable only for No. 2 plus beam must be revised accordingly. These revisions have been made, and it is recommended that gages shown on Figs. 1 to 9, inclusive, covering the minimum and maximum dimensions for the component parts and assembly of the A.R.A. standard No. 15 brake beam be included in the next issue of

Section B of the Manual with the following brief references. [Drawings and reference notes relative to the use of the nine gages is omitted in this abstract—EDITOR]

The report was signed by G. H. Wood (chairman), supervisor air brakes, A.T. & S.F.; W. H. Clegg (vice-chairman), chief inspector air brake and car heating equipment, Can. Nat'l; B. P. Flory, superintendent motive power, N.Y.O. & W.; T. L. Burton, air brake engineer, N.Y.C.; M. Purcell, general air brake inspector, Nor. Pac.; W. J. O'Neill, general mechanical superintendent, D. & R.G.W.; M. A. Kinney, general master mechanic, C. & O.; H. A. Clark, general air brake inspector, M. St.P. & S.S. M.; R. C. Burns, general foreman, Pennsylvania and L. S. Ayer, general air-brake inspector, So. Pac.

Action.—The report was adopted and the recommendations referred to letter ballot.

Report on Locomotive Construction

The Committee on Locomotive Construction has, during the year, given consideration to the following 12 subjects:

A.—Advantages and disadvantages of higher boiler pressure.
B.—Development and use of oil-electric locomotives.
C.—Counterbalancing of locomotives.
D.—Standardization of safety valves.
E.—Wheel centers of thin-wall section type.
F.—Light-weight pistons.
G.—Locomotive axles.
H.—Study of failed parts of locomotives—methods of reporting, analyzing and correcting such failures.
I.—Roller bearings for locomotives and tenders.
J.—Steel welding neck flanges.
K.—Driving and trailer tires.
L.—Code of Rules to govern the number and handling of locomotives which failed on the road due to broken parts.

Code of Rules to govern the preparation of locomotives for storage in good order and care of such locomotives while in storage.

Code of Rules to govern the firing up of locomotives.

Higher Boiler Pressure

Multiple-Pressure Locomotives.—The 2-10-4 Canadian Pacific multiple-pressure 250-850 lb. three-cylinder oil-fired locomotive No. 8000, was placed in service July, 1931. Details entering into the construction showed excellent examples of how metallurgical developments have permitted constructions not possible a few years ago, for instance—stainless steel for valves and valve seats have surmounted the limitations of bronze and the corrosion defects of ordinary steel, and stainless steel baffle plates for protecting direct oil flame contact with the drums. Low-carbon nickel steel for seamless drum construction has permitted a high factor of safety with reduced weight, and nickel steel boiler plates in the low pressure boiler has also given requisite strength with approximately 30 per cent reduction in weight.

Performance has been reported as showing considerable saving in fuel.

The New York Central multiple pressure 250-850 lb. three-cylinder 4-8-4 type locomotive No. 800, owing to general conditions, has not been placed in service, nor have any road tests as yet been conducted.

Water Tube Firebox Boilers.—As stated in former reports the B. & O. placed in service January, 1931, two locomotives of the 4-8-2 type and two of the 2-6-6-2 type, designed for 250 lb. steam pressure, one each with a watertube firebox and the other with a conventional radial-stay firebox and syphons. Reports of October, 1933, showed that the 2-6-6-2 locomotive with conventional firebox operating in freight service has had side-sheets and syphons renewed once, and was again being held for second set of side sheets, on account of cracks developing around staybolt holes.

The 4-8-2 locomotive, with water-tube firebox, accumulated 221,933 miles to September, 1933, and the 2-6-6-2 locomotive with the same type of firebox 161,091 miles at the same time. No repairs to either of the water tube fireboxes have been made since they have been in service. Both engines, however, have received new flues on account of the heads being fire cracked.

A passenger engine, 4-6-2 type with 80 in. drivers and 230 lb. steam pressure equipped with water-tube firebox boiler up to September 30, 1933, had made approximately 350,000 miles.

From these encouraging resul's the B. & O. built at its Mount Clare Shops, December 1933, a 4-6-4 type passenger locomotive with the same type water-tube firebox boiler, but to operate with 350 lb. steam pressure, 74 in. drivers, tractive force 52,000 lb., with booster 64,100 lb., firebox heating surface 825 sq. ft. with boiler capacity (Cole rating) of 124 per cent. Opportunity will thus be offered to learn what effect the higher pressures and temperatures will have on the boiler and steam distribution.

The Delaware and Hudson water-tube firebox of their design as applied to locomotive No. 1400 built in 1924, 350 lb. pressure; 1401, 400 lb. pressure; 1402, 500 lb. pressure led to the building of the fourth locomotive No. 1403, (The L. F. Loree), 500 lb. pressure,—being a four-cylinder compound 4-8-0 type. It was exhibited at The Century of Progress Fair, Chicago, and has had little service. They advise that these pressures have worked out satisfactorily and up to the present nothing has developed from a boiler or an engine standpoint that would justify a discontinuation of such pressures and the advantages that can be obtained through the use of same.

Conventional Radial-Stay Firebox Boilers.—The Atchison Topeka & Santa Fe reports that as regards locomotives carrying boiler pressures of 220 to 300 lb., the situation remains unchanged since the report a year ago. No new locomotives have been built since nor have they reduced the boiler pressure of any locomotives carrying 275 to 300 lb. pressure, neither have they increased the pressure on any other locomotives. Their locomotives carrying 275 and 300 lb. boiler pressure are giving satisfactory boiler performance and there is no outstanding feature in the maintenance or operation of these boilers to distinguish them from others of similar size and capacity that are operating under similar conditions.

The Canadian National Railway in previous reports advised that high silicon steel was being used in barrel courses, dome liners and welt strips, this permitted the use of thinner sheets, and that all staybolts were made of steel. No further information is available, excepting that they are convinced that the aim should be for higher boiler pressure.

The C. & N.W. and the C.St.P. M. & O. reports that the 12 C. & N.W. 2-8-4 type freight locomotives which carry 240-lb. steam pressure, have been in service over six years, the service has been very satisfactory, and maintenance on the boilers is no greater than for the boilers carrying lower pressure. The thirty-five, 4-8-4 type freight and passenger locomotives which carry 275 lb. pressure, have been in service over four years with the same satisfactory service. The material for the boilers of these locomotives is carbon steel, and the staybolts and radial stays are of wrought iron. From experience had with these locomotives they believe that to obtain the greater economy and the best operating service from locomotive boilers, the steam pressure should not be less than 250 lb.

The Kansas City Southern reported that work on Mallet No. 750, pulverized coal and lignite oil burner, was discontinued due to conditions, but hope by next year to have additional information.

The Lehigh Valley has 11 locomotives operating at 250 lb. boiler pressure and 11 at 255 lb. The first of these locomotives were placed in service about three years ago and the entire boiler, with the exception of material entering into the construction of syphons and smokebox sheets was of nickel steel. The fireboxes and combustion chambers were all welded, no rivets being used in the construction of the firebox. With the exception of one row above the mud ring which is hollow drilled rigid bolts, the balance of the bolts are hollow drilled Flannery two-piece flexible staybolts. So far these boilers have given very good service and practically no maintenance, and no firebox trouble known of any of them, with the exception of one small crack in an inside throat sheet. They contemplate purchasing some additional locomotives on which the boiler pressure will be 275 lb., and it is the intention to have the boilers designed along the same lines as the 22 now in service.

The Missouri Pacific reports that it has eight locomotives of the 2-8-2 type carrying 250 lb. steam pressure; these boilers are built of carbon boiler steel and so far have given the best of results, with no increased maintenance cost. Five of these same have been in passenger service seven years and the others four years. It has also twenty-five 2-8-4 type locomotives carrying 240 lb. steam pressure which have been in freight service for four years. The boilers are constructed of regular carbon boiler steel; repairs on these boilers no greater than on boilers carrying less pressure.

The New York Central reported in 1932 that it had equipped two 4-6-4 type locomotives operated at 225 lb. steam pressure with nickel steel shell courses for experimental purposes. Since that time these two engines have been shopped and the indications, up to the present time, are that equally as good service may be expected from the nickel steel as from regular specification steel and with a considerable reduction in weight.

The Pennsylvania has some nickel steel barrel sheets in use; these have not been in service sufficiently long to furnish definite information as to their life and service. Also have some special staybolt material on trial, but have not changed their standard, and have found no reason to do so. Their boiler pressure for all new locomotives has been 250 lb. for a number of years, and have not exceeded this up to the present time.

The Union Pacific does not have any locomotives carrying boiler pressure higher than 220 lb. but does have 88 locomotives of the 4-12-2 type, three cylinders, carrying 220 lb. boiler pressure. These engines have been in service from four to six years. The boilers are of the conventional radial stay type using plain carbon steel plates, and the performance of these boilers has been very satisfactory. If building new locomotives would probably go to 250 lb. or even 275 lb. boiler pressure.

The subcommittee report was signed by G. H. Emerson, (chairman), J. E. Ennis and A. H. Fetters.

Oil-Electric Locomotives

The committee assigned to the subject of "Development and Use of Oil-Electric Locomotives" did not obtain much additional operating statistics for the year 1933 due to the relatively small number of Diesel locomotives constructed and purchased within the year. The greatest number built were purchased by one road.

At the present time the increased activity in this field would indicate that a considerable number of these locomotives will be added between now and 1935; so the committee will continue the study and report the further developments next year. Statement below shows the oil-electric locomotives purchased during 1933.

Operating Company	Hp. Rating	Builder	Weight Tons	No. Locos.	Oil-Eng. Per Loco.
L.V.	600	A.L.Co.	100	1	1 McI-S
DL&W	600	A.L.Co.	100	8	1 McI-S
DL&W	600	G.E.	100	4	2 I-R
CB&Q	460	Mid-West	65	3	2 Cummins
N&B	800	B.L.W.	115	1	2 Westinghouse
N&B	530	B.L.W.	65	1	2 Westinghouse

The subcommittee report was signed by S. S. Riegel, (chairman), W. I. Cantley and W. F. Connal.

Counterbalancing

The committee's crosscounterbalancing of locomotives report of 1930 recommended a static balance of 50 per cent of the reciprocating weights to be divided equally among the coupled drivers. In the case of the locomotive under consideration in that report this worked out to a dynamic reciprocating balance of 31½ per cent and for other locomotives of like type the reciprocating balance would be between 30 per cent and 35 per cent after the main wheels were given a complete rotating balance by crosscounterbalancing.

In the supplementary report last year we asked that the proportion of reciprocating balance allotted to the main wheels be added to the immediate, the Wc component, before this component is combined with the cross or Wr component to find the final weight of the counterbalance. By doing this the reciprocating balance becomes the same as obtained with the A.R.A. method of 1915 with the advantage that the rail stresses are better distributed because the main wheel is fully balanced and the dynamic augment becomes the same for each coupled driver. The vibration or shaking effect of the locomotive as well as the track stress varies according to the proportion of the reciprocating weights balanced, provided of course, that the revolving weights are first taken care of by crosscounterbalancing.

Crosscounterbalanced engines given a 35 per cent reciprocating balance would not produce the rail stresses that are developed by a locomotive balanced with 50 per cent of the reciprocating weights according to the old method because of the lack of sufficient rotating balance in the main wheels by the old method.

For this reason it is possible to add 50 per cent of the reciprocating balance to crosscounterbalanced wheels to produce smoother operating engine which probably will not produce any higher rail stresses than when balanced by the former method but one that may increase the track stresses affecting bridge structures. Rail stresses were high because of insufficient main wheel revolving balance but track stresses are high when reciprocating balance is increased. In all this work we recommend distributing the reciprocating balance evenly among the drivers which is the proper method when the main wheels are given the proper rotating balance.

Where there are two main wheels such as the locomotives whose main rods are coupled to the main side rods, the second pair of main drivers should be crosscounterbalanced as well and be given its portion of reciprocating balance as is done with the conventional type of coupling. With the old method there was an advantage in distributing the balance in such a way as to give the main wheel the larger percentage. This came about because of the fact that the revolving component in the main wheel was not fully balanced and by adding the extra reciprocating balance in this wheel the revolving weights on this wheel were more nearly balanced. In the case of crosscounterbalancing where a perfect revolving balance is to be had, there is no object in doing this; it is better to distribute the reciprocating balance evenly so each wheel has the same dynamic augment.

Inasmuch as the crosscounterbalancing will lighten the dynamic augment, we feel that we are justified in increasing the reciprocating balance in cases where it does not exceed the augment formerly produced with the old method and believe that in most cases 40 per cent dynamic balance will not cause any greater stress on the rail and little higher track stress. By doing this we will obtain a much easier riding locomotive and one that should have much lower maintenance expense in the matter of broken and worn boxes, crossties and frame bolted parts.

As pointed out in our previous report, it is either a matter of favoring the engine or the track. We are now of the opinion that increasing the dynamic balance will save the engine without appreciably increasing the load on the track and recommend such procedure.

The subcommittee report was signed by S. S. Riegel (chairman).

Safety Valves

In compliance with request the committee has undertaken an investigation of locomotive safety valves to determine what features of design, construction and maintenance could be advantageously standardized.

A questionnaire was mailed to various roads, as well as to the locomotive builders and principal manufacturers of locomotive safety valves. The information received indicates that rules now appearing on page 71, Section F of the Manual, might well be supplemented by additional matter with regard to various features of safety valve construction, application and maintenance, but the committee desires more time in which to investigate this subject fully. It is therefore proposed to continue it on the docket for the next year.

The subcommittee report was signed by H. H. Lanning (chairman), Geo. McCormick, C. Harter, D. S. Ellis and A. H. Fetters.

Wheel Centers with Thin-Walls

In 1928, this committee submitted designs of locomotive driving and trailer wheel centers of the conventional spoke type which were adopted and are described on pages 3 and 4, Section F of the Manual, and drawings immediately following.

During the last three years, wheel center designs of a new type have been developed which, it is claimed, overcome certain inherent shortcomings of the conventional spoke type design. The new design has relatively thin walls arranged in either double-disc or box-type sections. As constructed to date, these thin-wall section wheel centers are of three different designs as follows:

(1) Double-disc type, consisting of an inner and outer disc joining the hubs and rims with no transverse members other than the walls of counterweight pockets and tubular openings to permit application of knuckle joint pins, etc.

(2) Box-section type, consisting of inner and outer discs united at suitable intervals by transverse radial walls resembling spokes.

(3) Hollow spoke type, in which a small number (usually four) of large spokes of substantially rectangular box-section are employed.

The principal advantages claimed for these wheel centers are the same for all designs, viz.:

(a) Superior casting design enabling the foundry to produce castings without voids, shrinkage stresses, etc., which, in wheel centers of the spoke type, have been productive of numerous failures.
(b) Greater strength, both radially and transversely.
(c) Uniform and more substantial support for rim section and tires.
(d) Improved counterbalance characteristics.
(e) Lighter total weight.

The disadvantageous features mentioned by users of the disc and box-section type of wheel centers are as follows:

(a) Impaired visibility of, and access to, certain parts such as springs, equalizers, spring hangers, spring hanger pins, shoes and wedges, hub bearings, etc., which require frequent inspection, lubrication, repairs or adjustment.
(b) Inconvenience of removing and replacing side rod knuckle joint pins.
(c) Impaired circulation of air around boxes and hubs, causing bearings to run at somewhat higher temperatures than with wheels of the spoke type.
(d) Insufficient stock in rim sections to allow for truing up wheel centers which become flattened or distorted in service.

Practically all the interest aroused in the disc or box-section wheel center has been in driving wheel design, particularly main driving wheels. However, a few of the disc type have been applied to trailer trucks.

A list of roads having in service wheel centers of the disc and box-section types is attached. [List shows application of 158 "double-disc" type centers on 71 locomotives of 18 roads and application of 120 "boxpok" centers on 48 locomotives of 12 roads.—EDITOR]

The purpose of this report is to present in condensed form the available information. No road using wheel centers of this type has had enough experience to prove or disprove definitely the claims made for the designs, consequently the committee submits no recommendations.

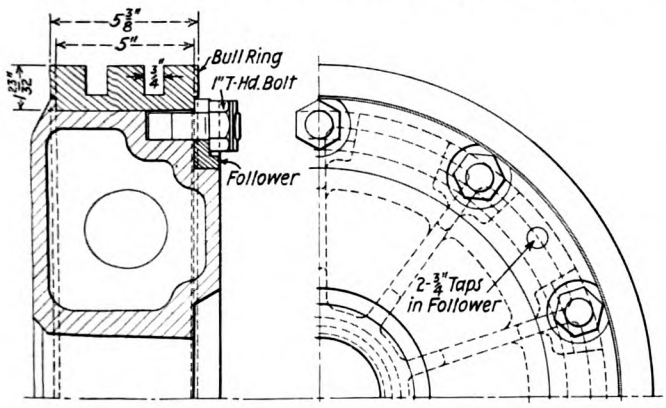
In so far as the committee has been able to ascertain, no laboratory tests have been made to determine the relative strengths of spoke vs. disc or box-section type of wheel centers.

The subcommittee report was signed by H. H. Lanning (chairman), Geo. McCormick, C. Harter, D. S. Ellis and A. H. Fetters.

Light-Weight Pistons

In 1928, on recommendation of this committee, the designs of piston heads and piston rods, referred to on page 107, Section F of the Manual and shown on plate 7, were adopted as recommended practice. When making its recommendations, the committee proposed a design of piston head that would permit the use of practically any arrangement of packing rings, but refrained from recommending any particular type of packing. It was well known, however, that a large majority of the roads were using bull rings as shown in style 2 of plate 7, these bull rings being grooved to suit individual standard designs of snap rings or packing rings of other types.

Since 1928 there has been several improvements in piston design. One is a light weight piston of hollow cast steel used by the Canadian National Railways. The application of bronze



Light-weight piston of hollow cast-steel type with bull ring used by Canadian National Railways

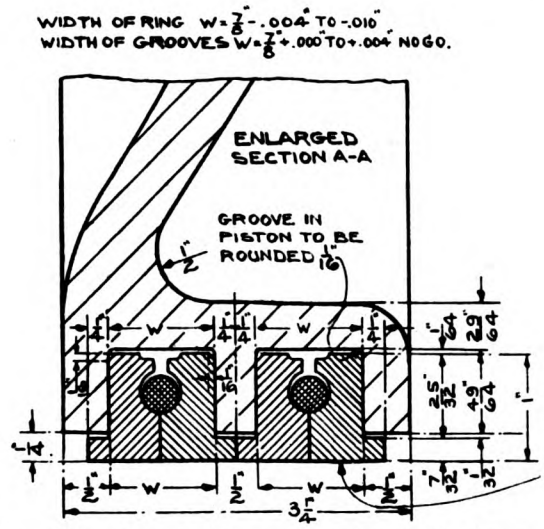
to the peripheral surfaces of pistons of the type designated as style 1, plate 7 of the Manual, has been practiced by some roads to reduce friction and wear. This obviates the necessity for applying bull rings. Some experimental work has also been done with bull rings of solid bronze. These experiments have been attended with considerable success in preventing excessive wear of cylinder bushings. There has also come into quite extensive use at least two designs of packing applicable to pistons of styles 1 and 2, plate 7, of the Manual, in which the packing rings carry the weight of the piston, thus performing the functions of both bull ring and packing rings. The principal objects sought in the design and application of all these special designs of pistons and packing rings are:

(a) To reduce weight of reciprocating parts.
(b) To simplify construction.
(c) To improve anti-friction properties.

The benefits of reduced wear, lower maintenance cost, improved counterbalance and greater freedom from failures are obvious.

Statements of roads using the combination bull ring and packing reflect generally satisfactory results, although two roads report unsatisfactory results from tests on a few locomotives. Locomotive mileages of as much as 250,000 between packing ring renewals were obtained on one group of ten locomotives of the 4-6-4 type in heavy passenger service. The cylinder bushings of these locomotives have developed so little wear while running the mileage given that it has not been necessary to bore any of them during the four years that the packing rings have been in service. This group of locomotives is equipped with sectional packing rings of phosphor bronze and has been operating under especially favorable conditions. Results obtained in locomotives of other types, classes of service, and on other territories indicate that lubrication, water conditions, grades, fuel and other operating conditions affect the results obtained, although in general the service rendered by packing rings of this type is superior to that obtained from the conventional bull ring and snap rings. The care exercised in fitting packing segments to the surfaces of the cylinder bore, as well as close fitting to the piston grooves, has been found to be essential to successful operation of combination bull ring packing, particularly when the segments of this packing are of bronze.

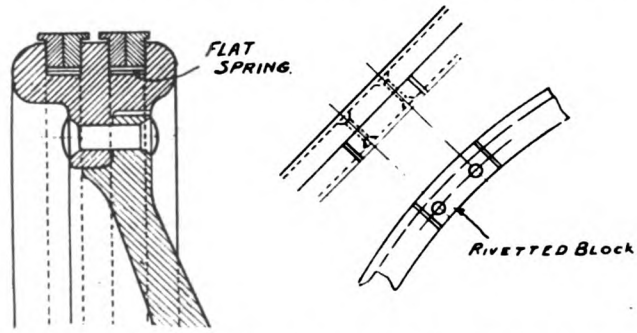
One road using light-weight pistons and combination bull ring packing states that the service rendered is much better than formerly obtained from snap rings and cast iron bull rings. Another road, which has a large number of locomotives equipped



Light weight piston with combination bull ring packing

reports that they are obtaining an average mileage of about 36,000 between packing ring renewals, whereas snap rings ran only about 14,000 miles and cast iron bull rings about 21,000 miles under the same conditions. Another road operating locomotives with light weight pistons and combination bull ring packing makes the following statement: "A study of our records for the past eight years in which these light weight pistons have been in service, when compared with other engines of the same type, shows that failures per locomotive of the bull ring type are 2.7 times as great as the failures, per locomotive, of the light rolled steel pistons." This road also reports that the light weight pistons, with rings carrying the weight, cost for maintenance less than the conventional bull ring type in the ratio of about 15 to 17. A western road, which is operating a large number of locomotives equipped with combination bull ring packing of bronze, reports that the cost of maintaining pistons of light construction, including packing rings, is approximately 35 per cent less per locomotive per annum than pistons and packing of conventional type.

The D. & R. G. W. is using pistons and rings of another design. The earliest application was made in November, 1931, to



D. & R. G. W. bronze sectional piston packing

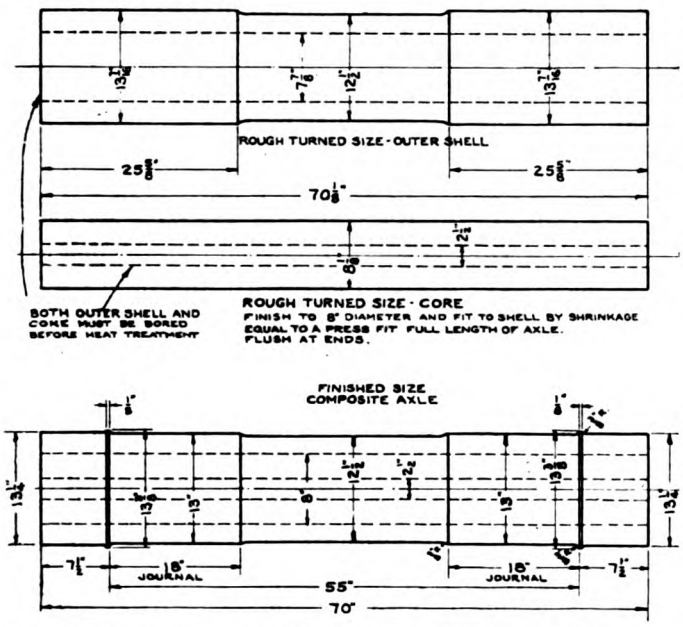
locomotives of the 4-8-4 type in heavy mountain passenger service. Application has since been extended to other locomotives of the pacific, mountain and Mallet types in both freight and passenger service, and at present 43 locomotives are so equipped, the average period of service with this type of piston and packing being about two years. A considerable part of the mileage is on long descending grades, down which the locomotives drift

without using steam. The packing rings used are of bronze. These locomotives were formerly equipped with cast iron bull rings and snap rings, and when so equipped packing consumption was high. The average mileage with bronze rings is reported as being 1216 per cent of that made with iron snap rings. The cost of packing maintenance is said to be $0.83 per 1000 locomotive miles for bronze rings as compared with $7.08 for iron snap rings. It has not been necessary to rebore or rebush any cylinders in which bronze rings are used, some of the locomotives having made 220,000 miles since the initial application.

The subcommittee report was signed by: H. H. Lanning, (chairman), Geo. McCormick, C. Harter, D. S. Ellis and A. H. Fetters.

Locomotive Axles

On account of axle failures on some roads, the committee has been requested to review its work on this subject. After careful consideration, we feel that no change should be made in the



Delaware, Lackawanna & Western composite driving axle

recommend practices with respect to axle and crank pin designs adopted in 1927 and appearing on pages 99 to 102, Section F of the Manual.

Some experimental work, however, is being done by the D. L. & W. in developing stronger and better axles than can be produced from solid forgings. They have a number of locomotives equipped with axles of composite construction made by inserting an 8 in. shaft or core of high tensile chrome nickel steel into a 13 in. outer shell of steel having chemical and physical properties best adapted to withstand the friction and heat of journal bearings.

It is claimed that axles of this construction can be made 32 per cent stronger than a solid nickel steel axle of same dimensions. Wear limits can be increased as progressive fractures, which, in nearly all axles, originate on the surface, would involve only the outer shell. The inner core would provide sufficient strength to hold a fractured axle together until detected by inspection, and complete axle failures would thus be eliminated. The outer shell, when damaged or worn to limit, can be replaced readily and the inner core continued in service. The relatively thin sections of core and shell afford opportunity for effective heat treatment and insure maximum freedom from internal stresses set up during forging and quenching.

The first axle of this type was applied October, 1931, to the main driving wheels of a 4-8-4 type locomotive from which three axles had been removed after short periods of service averaging 58,768 miles per axle. The original composite axle is still in service and in good condition after running 144,725 miles, and six other locomotives of the same type have been equipped. Four of these additional locomotives have accumulated more than 100,000 miles each since composite axles were applied.

The Lackawanna is also experimenting with main crank pins of similar construction. These crank pins are on five locomotives, three of which have run more than 100,000 miles each since application. The service rendered to date by these pins is said to be superior to that previously obtained from solid pins in the same locomotives.

The subcommittee report was signed by H. H. Lanning (chairman), Geo. McCormick, D. S. Ellis, C. Harter and A. H. Fetters.

Study of Failed Parts

The committee has considered methods of reporting, analyzing and correcting such failures followed by several prominent roads.

On roads where it is impossible for the mechanical engineer or all in charge to personally inspect all failures and defects, a system for collecting this information is desirable. As this requires help from men employed at the points of occurrence where it is not easy to investigate properly and make out comprehensive reports, this method simplifies getting the important information for a proper study and correction of the failure.

With welding developed and older power becoming obsolete, the value of reporting occasional defects in heavier parts such as frames, cylinders, etc., but as the lighter parts can easily be replaced by better designs or materials they should be reported and in such cases we suggest the mechanical officer issue regularly to all master mechanics, roundhouse foremen, shop superintendents, general foremen and all interested, a questionnaire asking for desired information on breakages of parts occurring frequently where seemingly redesign may eliminate the trouble.

[The full report gives complete details of a change card system together with examples of the method of using it.—EDITOR.]

The subcommittee report was signed by S. S. Riegel, chairman), D. S. Ellis and R. G. Bennett.

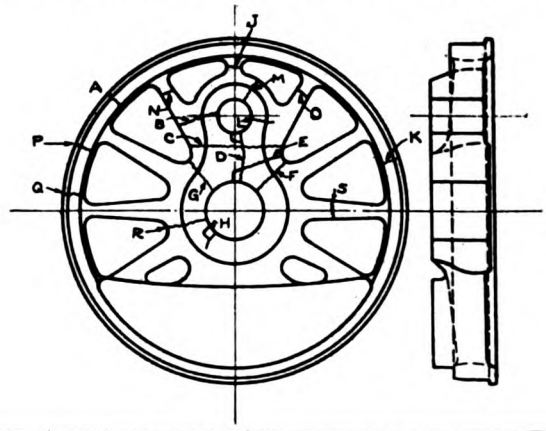
Roller Bearings

Replies to questionnaire dated March 17, 1934, were received from 43 roads. Twenty-six reported roller bearing installations as follows:

Engine trucks	286
Main driving axles	2
All driving axles	6
Trailer trucks	24
Tenders	254
Tender Boosters	25
Electric locomotives (includes drivers and lead trucks)	75
3-Cylinder valve gear (Transverse levers)	73

One road reported roller bearing applications to back end of main rods and main connection of side rods on one 4-6-2 type locomotive. Another reported similar application now being made to one 4-6-2 type locomotive.

No roller bearing applications were reported to Walschaert or other valve gear parts, however, one road (U.P.) has 73 three-



LOCATION OF FRACTURES																	
A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S
1008 R.M.	850 L.Int	835 R.M.	842 R.M.	1132 L.M.	1106 L.M.	1132 R.M.	1032 R.M.	874 L.F.	869 R.Int	805 R.M.	874 L.F.	874 L.F.	874 L.F.	869 R.Int	1010 R.F.	1008 R.B.	1008 R.F.
	874 L.Ft.	841 R.M.	850 R.M.	1106 R.M.				1008 L.B.	1008 L.M.		869 R.Int	869 R.Int	1018 L.F.	880 R.Int	1022 R.F.		1008 R.M.
	898 L.Int	845 R.M.	864 R.Int					1006 L.M.			880 R.Int	880 R.Int		1008 R.M.			
	1028 R.M.	847 R.M.	874 L.Ft.					1008 R.B.			1008 R.Int	1008 R.Int		1010 L.F.			
		851 R.M.	1030 R&LM					1008 R.M.			1018 R.F.	1015 R.F.		1022 R.F.			
		893	1034 R.M.														
		1131 R.M.															
		1132 L.M.															
		1134 L.M.															

Typical tabulation of failures of locomotive driving wheels

cylinder locomotives equipped with roller bearings in large and small transverse levers. (Gresley gear.)

Not all roads replied and in other cases incomplete data was returned. There seems to be no doubt in regard to the superiority of roller bearings although there are some features which require further development, one of which is the question of axle design. On the other hand, several replies indicate adverse experience on tender journal applications, but based on comparatively few installations. The entire roller bearing proposition is still more or less in its infancy and it is felt by the committee that four or five years more will be required for further experimental and research work, to insure a complete back-ground of the best practices. For future study, the subcommittee suggests standard methods for reporting roller bearing or axle failures. These reports should be made periodically to the Secretary on prescribed forms. Compilation of data on such report forms will assist to develop accurate results for eventual standardization of numerous roller bearing details.

The subcommittee report was signed by A. H. Fetters (chairman), R. L. Bennett and W. F. Connal.

Steel Welding Neck Flanges

Study of information received and experiences by extended use of welding neck flanges by the users, especially the experience of one large road which has used this extensively since 1918 by placing in service a large amount of steel steam piping for power plants, shop lines and other service piping for pressures of 150 lb. and temperature ranges of 500 to 750 deg. F., and using this arrangement for steam pipes between superheater header and cylinders for locomotives at pressures of 250 lb. and temperature ranges between 500 and 750 deg. F., with full success; your committee finds these practices and dimensions for steam pipe sizes of 1 to 14 in. in diameter conform exactly to the proposed American Standard for steel welding neck flanges developed and proposed by the A.S.M.E., which is being distributed for criticism. The A.S.M.E. recommendation covers steel pipe flanges designed to be made up in this manner to provide an alternate for screwed and lapped connections. We concur in that proposal for such sizes and pressures as are commonly used by railroads, and also propose it as an A.R.A. recommendation, subject to such changes as may finally be made standard by the A.S.M.E.

The subcommittee report was signed by S. S. Riegel (chairman), J. E. Ennis and W. I. Cantley.

Driving and Trailer Tires

The subcommittee was appointed to cooperate with the Technical Committee of the Tire Manufacturers Association in determining what improvements, if any, are possible in tire manufacturing to overcome failures due to internal defects, and with the Specifications Committee, to cover recommendations as to specifications and tolerances, with the thought of bringing the product up to meet present-day operating conditions. The subcommittee is assembling data for a later report.

The subcommittee report was signed by R. L. Bennett (chairman), J. E. Ennis and W. I. Cantley.

Failures—Storage—Firing-Up

The following subjects were assigned to this subcommittee:

Code of Rules to Govern the Number and Handling of Locomotives which Failed on the Road Due to Broken Parts.

Code of Rules to Govern the Preparation of Locomotives for Storage of Locomotives in Good Order and Care of Such Locomotives While in Storage.

Code of Rules to Govern the Firing-Up of Locomotives.

Data is being assembled and tabulated in an effort to arrive at recommendations. This docket will be continued and report submitted as soon as completed.

The subcommittee report was signed by: D. S. Ellis (chairman), R. L. Bennett, C. Harter and A. H. Fetters.

The full report was signed by W I. Cantley (chairman), mechanical engineer, L.V.; H. H. Lanning (vice-chairman), mechanical engineer, A.T. & S.F.; R. G. Bennett, general superintendent motive power, Pennsylvania; G. McCormick, general superintendent motive power, Sou. Pac.; W. F. Connal, mechanical engineer, Can. Nat'l; G. H. Emerson, chief motive power and equipment, B. & O.; A. H. Fetters, general mechanical engineer, U.P.; J. E. Ennis, engineer assistant, N. Y. C.; S. S. Riegel, mechanical engineer, D. L. & W.; D. S. Ellis, engineer motive power, C. & O., and C. Harter, chief mechanical engineer, Mo. Pac.

Action.—The report was accepted and the sections pertaining to counterbalancing, safety valves and tires referred to letter ballot.

Couplers and Draft Gears

Your Committee on Couplers and Draft Gears submit report covering activities during the past year:

Couplers

Interchange Rules 18 and PC-7: Extending and defining the limits for cracks in knuckle tail side wall. Recommendation was made to Arbitration Committee relative to extending and more clearly indicating limits for cracks appearing in the knuckle tail side wall to justify removal. (See report of Arbitration Committee.)

Interchange Rules 18 and PC-7: Application of second-hand couplers, or replacement of defective parts thereof. The committee recommended to the Arbitration Committee that the limit for second hand couplers be set at 5 in. instead of 5⅛ in. as shown in Interchange Rules. This recommendation was not accepted, but the Arbitration Committee asked the concurrence of the Coupler Committee in a revision recommending that the 5 in. limit shall be established where a second-hand coupler complete or a new coupler body is applied, but where repairs are made by the renewal of parts other than the body the 5⅛ in. limit will be retained. The committee concurs in this revision.

Interchange Rule 23—Section III, Building up worn surfaces by autogenous welding. Where Section III refers to coupler reclamation, it is recommended that it be revised to specify machining the butt and then welding on a plate as shown on a drawing.

Interchange Rule 23—Section IV: Welding cracks in guard arm and back wall of coupler head. Limits have been established to cover the extent of cracks in the knuckle tail side wall before couplers with such cracks should be removed from service. The committee was requested to establish limits for such cracks in the knuckle tail side wall beyond which couplers should not be reclaimed. It is, therefore, recommended that Rule 23, Section IV be revised by adding "and including couplers with horizontally inclined cracks not over 7½ inches long or extending beyond the limits indicated in Figure C of Rule 18."

Limits for Shank Length and Wear between Butt and Key-Way for Second-hand Classification. Request for recommendation for second-hand classification with respect to coupler shank length and wear between pulling surface of key-way and coupler butt was referred to this committee. It is recommended that couplers with shanks less than 21 in. in length (new 21¼ in. plus or minus ⅛ in.), measured from the striking horn to the crest of the curved surface of the butt, should not be classed as second-hand value. Also couplers upon which the butt aud the pulling surface of the key-way have worn so that the distance between these two surfaces, established with parallel straight edges, is less than 3⅞ in. (new 4 in., plus 3/32 in., minus 0 in.) should not be classed as second-hand value.

Welding of cracks in Knuckle Tail Side Wall. It has been reported that some couplers that have been welded in the knuckle tail side wall were cracking again in the same location. The committee has investigated and finds there have been very few such cases observed and is led to conclude that where couplers are cracking in the knuckle tail side wall, after having been welded in that section, they probably have not been repaired in accordance with recommendation with respect to normalizing after welding.

Observations of welded couplers that were properly normalized after welding indicate conclusively that such couplers when subjected to extreme conditions in butt or impact are more likely to fail in some other than in the welded section.

Knuckle Pins. A multiplicity of designs of knuckle pins are now used. It is felt that this number can be greatly reduced and all coupler service taken care of by the 14 pins shown in Sketch 802 (omitted from abstract). The coupler manufacturers have made a survey of this subject and support the committee in this recommendation.

Type "E" Coupler. The Type "E" Coupler is being introduced as new couplers are required and is giving generally good results. There have been some service developments indicating slight minor changes to improve operation which is being taken care of by the coupler manufacturers.

Cast Steel Yokes

A study has been made with the view of adopting a standard cast-steel coupler yoke that might be substituted for present standard 1¼ in. x 5 in. wrought yoke. Developments so far, indicate that establishment of such a standard presents an almost insurmountable problem. One coupler manufacturer has produced 110 designs of cast-steel yokes in the normal course of demands while another manufacturer stated that they have 18 designs.

One difficulty in developing a standard design is the uncertainty of the patronage that might be expected and this is hindering developments. If one or more designs are to be recommended it will probably be necessary to develop from the various roads upon what equipment they might consider use of cast-steel yokes in substitution for wrought yokes. Information developed from such an inquiry might eliminate a number of designs and simplify the problem into a workable proposition.

Draft Gears

Approval Tests. To date, six manufacturers have submitted draft gears for approval test at the Association laboratory at Purdue University, some manufacturers submitting more than one type. In some cases manufacturers withdrew the gears after the tests showed that they would not meet specification requirements, and then asked for a new test after the gear had been improved. Certificates of approval have been issued for seven types of standard pocket draft gears made by five manufacturers, as follows:

Waugh Equipment Company	Type 403	June	1, 1932
National M. & S. C. Co.	" M-17-A	Aug.	1, 1932
Westinghouse F. D. G. Co	" NY-11-E	Nov.	1, 1932
Cardwell-Westinghouse Co.	" L-25-SA	May	1, 1933
	" A-22-XB (Cyl. D7925)	Feb.	1, 1933
W. H. Miner, Inc.	" A- 2-XB (Cyl. D7940)	Apr.	1, 1933
Edgewater Steel Company	" B32-KA	June	20, 1933

Applications for approval tests on two additional gears—National M. & S. C. Co., Type M-50-A, and American Steel Foundries (Peerless), Type KA-6-K (type changed)—are on file awaiting manufacture of a sufficient number from which test specimens can be selected. One manufacturer, Waugh Equipment Co., has made an improvement in his gear since it was officially approved and the changes have been approved after a special test.

In granting a certificate of approval, the subcommittee has followed the policy of requiring the manufacturer to designate the approved gear by a type symbol which will distinguish it from any other gear he makes. It is not permissible to mark any gear with this symbol unless all parts are exactly the same as in the approved gear. This will simplify the problem of providing for a gradual elimination from service of non-approved gears. When improvements are made in existing approved gears, no change in type designation is required provided the general construction and appearance are not changed and provided the manufacturer discontinues the manufacture of the older design. This will avoid an unnecessarily large list of types of approved gears. All changes, of course, must be approved.

Interchange Rules. Interchange Rule 3 (d) paragraph (1) now provides that approved draft gears are required on all cars built new on or after January 1, 1934. Paragraph (2) provides that a new draft gear when applied to a car on or after January 1, 1934, shall, when practicable, be an approved gear. Misunderstanding of the words "when practicable" has arisen, and in order to clear this up it is recommended that paragraph (2) be revised to read as follows:

"Draft gear, new, when applied to any car on or after July 1, 1934, shall comply with the foregoing specifications unless the pocket dimensions of the car are such that an approved gear cannot be applied."

The list of friction draft gears now given in Interchange Rule 101 is divided into Section 1 approved gears and Section 2, non-approved gears. Your committee is working with the Price and Arbitration committees to the end that the gears in Section 2 will be further divided, into non-obsolete and obsolete gears. The purpose of such classification is to remove all incentive for maintaining these obsolete gears in service. The proper classification requires conferences with the manufacturers and the work is being handled as rapidly as possible.

Limitation on Number of Approved Gears. Your committee is considering ways of avoiding the establishment and perpetuation of an undue multiplicity of standard draft gear types such as will result if certificates of approval are granted without limitation as to number. The uncontrolled working of such a system might eventually lead to a list of approved gears as large as that which now appears in Interchange Rule 101, Sec. 2. Numerous problems arise in devising ways of administering the situation so as to limit the number of different types of draft gears in use while not barring progress in development. One method is to limit each manufacturer to one certificate of approval with provision for superseding the gear by an improved gear at any time the manufacturer should so desire. It will require conferences with the various manufacturers to work out the details of a program acceptable to all parties.

Changes in Specifications. Based on experience gained during the making of approval tests certain minor changes in draft gear specifications have been decided upon and are recommended for adoption.

In the specifications for Approved Draft Gears for Freight Service a new paragraph is to be added. This will be paragraph 7 (d), the present paragraphs 7 (d) to (i) inclusive becoming paragraphs 7 (e) to (j) inclusive.

7. (d) "If in the judgment of the test engineer the operation of a gear under test is influenced either favorably or unfavorably by an accumulation of worn-off particles of metal within the gear, it may be dropped to a horizontal position occasionally in order to give these particles the same opportunity to escape that they would have if the gear were in service. However, no artificial method of cleaning by means of blowing or otherwise will be permitted."

In the instructions regarding certificate of approval for draft gears, paragraph 5 has been changed to read as follows:

5. "The gears to be tested shall be selected by a representative of the A. R. A. Subcommittee on Draft Gears. In order to be sure that the test specimens are average commercial gears of the type shown by the drawings and specifications, selection will not be made from a lot of less than 50 assembled gears or 50 complete sets of parts in the case of a gear that is sold disassembled. The gears selected shall be shipped to the A. R. A. Draft Gear Testing Laboratory at Purdue University in such manner as to be protected against exposure, damage, and loss or interchange of parts. Record of identifying marks will be separately forwarded."

It has been decided that paragraph 7 (b) in the specifications for Approved Draft Gears for Freight Service which permits the friction elements of a gear to be turned up or down according to the recommendation of the manufacturer will allow the gear to be turned one way for half of the endurance test and then inverted for the remainder of this test if the manufacturer so elects.

Draft Gear Design. Under date of February 8, 1934, Joseph B. Eastman, Federal Co-ordinator of Transportation, addressed M. J. Gormley, President of the A. R. A., in regard to conducting a series of tests to determine the necessity for increased draft gear travel or the use of selective travel devices, advising that the matter had also been discussed with the Bureau of Safety, I. C. C., and suggested that a meeting be held at which representatives of the Mechanical Division, A. R. A., including the chairmen of the Car Construction and Coupler and Draft Gear Committees, meet with representatives of the Section of Purchases and the Bureau of Safety, I. C. C., for formulating a program of tests.

This meeting was held on February 21, 1934, at which the following were present: C. W. Brown, assistant director, section of Purchases; W. J. Patterson, assistant director, Bureau of Safety, I. C. C.; S. N. Mills, assistant director, Bureau of Safety, I.C.C.; P. W. Kiefer, chairman, Committee on Car Construction; R. L. Kleine, chairman, Committee on Couplers and Draft Gears; H. A. Johnson, director of research, A.R.A.; W. S. Helmer, asst. to director of research, A.R.A.; and V. R. Hawthorne, secretary, Mechanical Division, A.R.A.

The following action was taken:

1. It is recommended that the A. R. A. collect all available data and determine what further investigations and/or tests may be necessary to further develop this subject.
2. This investigation would not produce results soon enough to be taken advantage of in connection with cars now proposed to be constructed, but improvement in such new equipment would result from use of the Type E couplers (now mandatory), swivel butt Type E couplers (an alternate standard), draft gears conforming to present A. R. A. specifications (now mandatory), "AB" brake equipment (now mandatory) and non-harmonic truck springs, the use of which is optional.
3. Immediate improvement on existing equipment can be accomplished by systematic inspection, maintenance and more progressive elimination of inefficient draft gears from service.

It is recommended that this subject be referred by the A. R. A. to the Committee on Couplers and Draft Gears and the Arbitration Committee to formulate appropriate rules to govern.

This was referred to the General Committee and approved. Under date of April 10, 1934, Secretary Hawthorne addressed H. A. Johnson, director of research, and advised that the following committee members were appointed to consider the advisability of conducting a series of tests to determine the necessity of increased draft gear travel or the use of selective travel devices.

Representing Committee on Couplers and Draft Gears: C. T. Ripley, H. W. Faus and L. H. Schlatter,

Representing Committee on Car Construction: T. P. Irving, A. H. Fetters and J. P. Laux.

Representing Committee on Brakes and Brake Equipment: G. H. Wood, W. H. Clegg and R. C. Burns.

A meeting of this committee was held, May 22, 1934, and unanimously decided that Chairman Johnson make a survey of all draft gear tests that have been made and prepare therefrom a summary which he will present to the members and then call a meeting to decide what further action should be taken especially as regards comparative road tests.

The following were appointed on joint committee to formulate appropriate rules governing a systematic inspection and maintenance of draft gears; Samuel Lynn (chairman), superintendent rolling stock, P. & L.E.; H. W. Coddington, engineer tests, N. & W.; T. J. Boring, foreman, M.C.B. Clearing House, Penna.; W. H. Flynn, G.S.M.P. & R.S. NYC and L. Richardson, mechanical assistant to vice-president, B. & M.

This committee held a meeting on May 23, 1934, at which tentative instructions were set up to govern the inspection and maintenance and a list of features to be given further consideration.

The report was signed by R. L. Kleine (chairman), assistant chief motive power, Pennsylvania System; H. W. Coddington (vice-chairman), engineer of tests, N. & W.; C. P. Van Gundy, engineer of tests, B. & O.; C. J. Scudder, superintendent motive power and equipment, D. L. & W.; S. Lynn, superintendent rolling stock, P. & L. E.; L. P. Michael, chief mechanical engineer, C. & N. W., and C. T. Ripley, chief mechanical engineer, A. T. & S. F.

Action. The report was accepted.

Report of Committee on Wheels

Cast Iron Wheels

Specifications—As stated in the second paragraph in the report of the committee, dated May 27, 1933, the fourth revision of the Manufacturers' Standard Foundry Practice Requirements for Cast Iron Wheels, dated March 1, 1933, was submitted to the committee and during the year has been thoroughly reviewed. It has been unanimously agreed that these latest revised Standard Foundry Practice Requirements will be substituted for the present foundry practice requirements incorporated in and made part of the Cast Iron Wheel Specifications. This substitution will be made in the next issue of revised pages to the Manual and will also be incorporated in the next issue of the Wheel and Axle Manual which is now underway.

Cast Iron Wheel Design—The subject of straight taper on cast iron wheels has been further considered during the year. One railroad has applied approximately 10,000 wheels having 1 in 20 straight taper on tread under refrigerator cars for test. This test has not yet progressed to the point which will warrant a recommendation for change in taper for cast iron wheels. This subject will be given further consideration during the coming year.

Cast Iron Wheel Defects and Condemning Limits—The committee has given consideration during the year to the matter of out-of-round wheels of all types but with particular reference to cast iron wheels. In this connection, the committee has been much interested in the tests conducted under the direction of the Committee on Car Construction in connection with harmonic spring action and other similar investigations and observations made by individual roads. Sufficient data, however, has not been available upon which to base a limit for rotundity which might justify the incorporation of a rule in the Interchange Rules restricting application of second hand wheels or withdrawal of wheels from service with this so-called defect. The committee will continue its study of this subject and will appreciate the cooperation of the members in accumulating data which will aid in the establishment of limits of rotundity for wheels.

The committee in its 1933 report called attention to its lack of information regarding cast iron wheel removals and recommended that the few roads reporting wheel removals for study use a uniform system and called attention to sample forms for this purpose which may be procured upon application to the Secretary or to the chairman of the Committee on Wheels. The committee has received some response to this request but not to the extent that was desired to enable them to make a proper study of the cause of wheel removals. It is earnestly hoped that other railroads and private car lines will cooperate with the committee in furnishing this information.

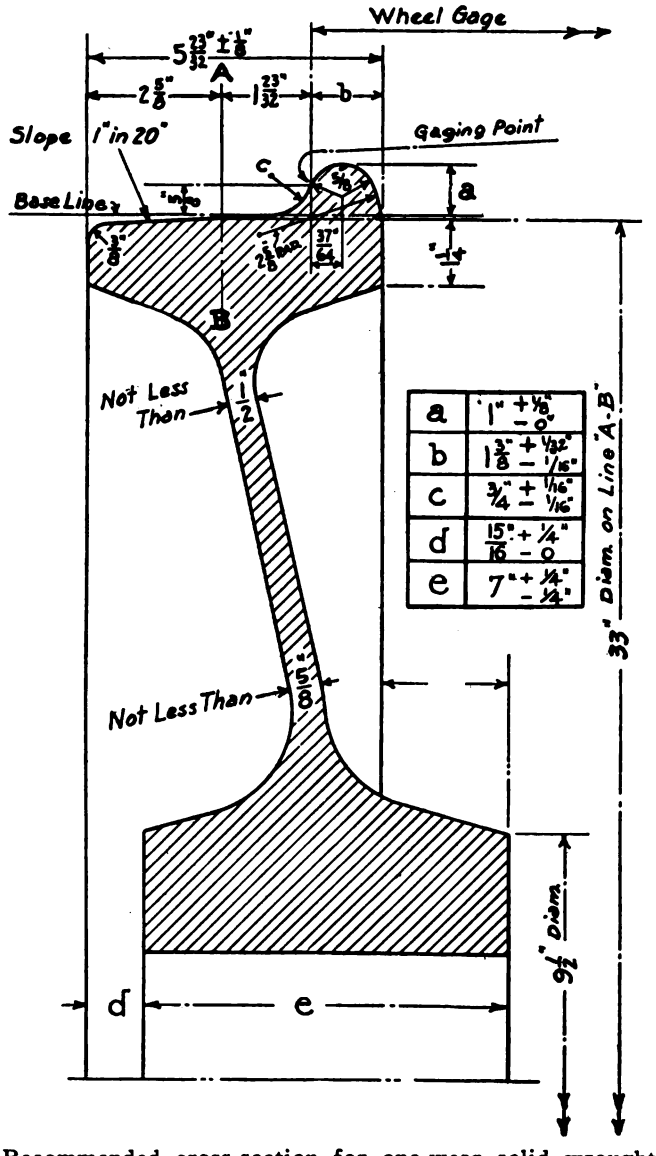
Wheel Defect Symbols—The application of wheel defect symbols in referring to wheel defects is becoming more and more appreciated as roads recognize the convenience and value of this system. Some of the roads utilize these symbols in providing an accurate and systematic method of reporting defects for which wheels are removed. Special tags for attaching to the axles of removed wheels have been provided by some roads for reporting certain definite information relative to the removed wheels. The defects are indicated by symbols and a tag shows a list of defects with corresponding symbol numbers. On one side of the tag is the form for reporting "Cast Iron and One Wear Cast and Wrot Steel Wheels," and the opposite side is prepared for reporting "Multiple Wear Wrot, Cast Steel and Steel Tired Wheels."

ARA symbols have not been established for axle defects, and the numerals 1 to 12, inclusive, have been assigned for convenient use in indicating wheels removed on account of condition of axle.

Where this practice has been employed it is reported that it has stimulated greater interest in the inspectors properly reporting wheels, since defects in wheels are checked against the tags when they arrive at the wheel shop, and it also serves the purpose of providing means of determining definite and reliable data as to cause of removal of all types of wheels. The committee wishes to endorse this practice.

Rules of Interchange—During the year the committee has considered a number of questions in connection with interpretations of the Rules of Interchange relative to wheel defects. These interpretations have been referred to the Arbitration Committee and have either been incorporated as changes in the Rules or interpretations of the Rules and will be taken care of in the report of the Arbitration Committee.

Mounting Tolerances for Cast Iron Wheels—During the year the Association of Chilled Iron Manufacturers has made an exhaustive study of mounting practices and while this study was largely confined to mounting practices of cast iron wheels the information developed is readily applicable to both cast iron and wrought steel wheels. In this study it was shown that there are influences that enter into mounting practices that may result in developing the desired mounting pressure, but may not necessarily result in a properly mounted wheel. It was also demonstrated that certain definite tolerances could not be adhered to, especially in mounting of cast iron wheels on account of variations in the wheels of different manufacturing plants; wheels from one plant requiring a greater differential between diameter of wheel seat and diameter of bore than wheels from another plant. It is felt, however, that for cast iron wheels the



Recommended cross-section for one-wear solid wrought carbon steel wheels

minimum tolerance in general, should be 0.006 in. and the maximum tolerance 0.009 in. This maximum tolerance is suggested to avoid excessive expansion of the hub which produces undue stress in that section. It was also demonstrated that the nature and consistency of the lubricant used on the mounting surfaces affects the pressure developed and that the mounting pressures may be reduced if the lubricant is unduly heavy.

The results of this research made by the Association of Chilled Iron Manufacturers will be incorporated in the revision of the Wheel and Axle Manual.

Revision of Standard Gages

Revision Of Tread Worn Hollow Condemning and Remount Gages—Experience with the tread worn hollow condemning and remount gages as shown in Section B, Page 52—1934 Manual, has suggested a revision of that section of the gage that contacts with the wearing face of the flange in order that the gage can be properly adjusted to a wheel that is full in the flange face dimension. This section of the gage is not an essential feature of its application and the committee recommends a change that will take care of this and at the same time provide a more simplified construction.

Limit Gage for Remounting All Cast Iron Wheels—The radius of the surface that contacts with the back of the flange is changed from $2^{31}/_{32}$ in. to $2^{5}/_{8}$ in. The point from which this $2^{5}/_{8}$ in. radius is struck is located $1^{9}/_{32}$ in. from the tread contact surface instead of $1^{1}/_{32}$ in. This to conform with the development of the cast iron wheel contour. The title for this gage should read: "ARA Limit Gage for Remounting All Cast Iron Wheels."

Limit Gage for Remounting One Wear Wrought and Cast Steel Wheels.—The radius of the surface that contacts with the back of the flange is changed from $2^{31}/_{32}$ in. to $2^{5}/_{8}$ in. The point from which this $2^{5}/_{8}$ in. radius is struck is located $1^{9}/_{32}$ in. from the tread contact surface instead of $1^{1}/_{32}$ in. This to conform with the development of the cast iron wheel contour. The title for this gage should read: "Limit Gage for Remounting One Wear Wrought and Cast Steel Wheels."

Steel Wheel Service Metal Gage—The portion of this gage that is used for determining the vertical flange has been changed from a radius of $^{11}/_{16}$ in. to $^{7}/_{8}$ in. and the tangent line that contacts with the tread on the wheel changed from approximately $1^{3}/_{4}$ in. to $1^{1}/_{4}$ in.; both changes having been made to conform with this section of the Wheel Defect, Worn Coupler Limit, etc., Gage. On the scale provided for indicating the flange height, the old gage shows graduation No. 7. This number has no practical use and is omitted in the revision of the throat radius section.

The committee suggests that the recommended changes in design and dimensions of the gages outlined above be submitted to letter ballot and the standard plates corrected upon approval of the Association.

Wrought Steel Wheel

At the annual meeting of the Association in 1926, reference was made in the report of the committee to the development of the one-wear wrought steel wheel, at which time the Technical Committee of the Wrought Steel Wheels Manufacturers submitted for consideration specifications for these wheels. The Wheel Committee was not satisfied with the specifications on account of rather liberal tolerances and requirements as to finish and stated that if and when these wheels came into more general use it would then be necessary for the Wheel Committee to submit to the Association a set of specifications covering their manufacture.

Since that time the development of the one-wear wrought steel wheels has progressed to the point where all wrought steel wheel manufacturers are now in position to roll one-wear wrought steel wheels, although the majority of these wheels in service to date have been manufactured by four of the companies.

In 1933 the Technical Committee representing the Association of American Steel Manufacturers submitted new specifications for the one-wear type of wrought steel wheels. These specifications were printed in the Letter Ballot Circular for 1933, DV-807, dated August 30, 1933, for the information of the members and comments and suggestions solicited. These specifications have been carefully studied during the past year by the Committee on Wheels, in cooperation with the Technical Committee representing the Association of American Steel Manufacturers.

The specifications have been revised and modified to meet the requirements of service and suggestions received. The design for this type of wheel is shown in one of the illustrations. The specifications were included in this report with the recommendation that they be submitted to Letter Ballot for adoption as Recommended Practice.

The report was signed by H. W. Coddington (acting chairman), engineer of tests, N. & W.; M. R. Reed, general superintendent motive power, Pennsylvania; C. T. Ripley, chief mechanical engineer, A. T. & S. F.; O. C. Cromwell, assistant to chief motive power and equipment, B. & O.; J. Matthes, chief car inspector, Wabash; C. Petran, supervisor tools and machinery, C. M. St. P. & P.; A. M. Johnsen, engineer of tests, Pullman Co., and D. Wood, engineer of tests, So. Pac.

Action.—The report was accepted and referred to letter ballot.

Tank Car Committee Report

During the year the committee considered a total of 203 dockets and applications for approval of designs, of which 102 covered shipping containers of the following classes, for application to new cars or for replacement on existing cars:

Class	No. of Tanks
ICC-103	148
ICC-103-A	50
ICC-103-B	28
ICC-103-C	2
ICC-104	5
ICC-104-A	1
ICC-105-A-300	79
ICC-105-A-400	1
ICC-105-A-500	35
ICC-106-A-500	30
ARA-201-A-20 (100 lb. bursting—20 lb. test pressure—experimental service)	1
ARA-201-A-35	16
ARA-201-A-35-W (Fusion welded seams)	10
ARA-203	1
ARA-203-W (Fusion welded seams)	1
ARA-203-X (Armco iron experimental tank)	1
Special construction—four forge welded tanks per car	8
Total	417

Six applications covered 15 multi-unit cars to be used for the transportation of 15 Class ICC-106-A500 one-ton chlorine containers each.

Eighty-four applications covered alterations in existing equipment consisting of:

Application of steam heater coils.
Application of electric heater coils.
Application of insulation.
Application of rubber lining.
Application of tank stabilizers.
Capacity reduced.
Converted to acid service.
Converted to caustic soda service.
Converted to wort service.
Converted from Class ARA-IV to ARA-III.
Converted from Class ARA-IV to ARA-III insulated.
Converted from single to double-compartment cars.
Converted from single to triple-compartment cars.

The classes and number of cars altered were as follows:

Class	No. of Cars
ARA-II	63
ARA-III	903
ARA-IV	16
ICC-103	153
ICC-103-A	1
ICC-103-B	5
ICC-105-A-300	2
Total	1143

Ten applications were for approval of tank car appurtenances as follows:

Applications	Tank Car Appurtenances
1	Center anchorage for repaired cars.
2	Forge-welded anchorage.
1	Gasketed wing type bottom outlet valve.
1	Heater pipe support.
2	Safety and angle valves for 105-A tanks.
1	Safety valve for 103 tanks.
1	Outlet valve for 103 tanks.
1	Welding metal placard holders to tank shell.

One application proposing a modification of the specifications covering angle valves for use on Class 106-A series tanks.

Fusion Welded Tanks

The Interstate Commerce Commission has not set a date for a hearing on the pending applications (No. 324 covering ten Class ICC-105A400, No. 371 covering one Class ICC-103C and No. 420 coverings ten Class ICC-103B tank cars) for approval of 21 tank car tanks constructed in accordance with effective specifications, except that fabrication is proposed to be by means of fusion welding, and on which your committee has recommended the authorization of experimental service trials.

Extension of Effective Dates for Interchange

In view of a continuance of unfavorable economic conditions your committee has recommended to the Arbitration Committee

that the effective date of Rule 3 (t) (7), covering head block anchorage, be further extended for a period of one year.

Your committee has also recommended that the effective date of Rule 3 (t) (8), covering wooden shims between center anchorage and underframe, be further extended for a period of one year for the same reason.

Leakage of Safety Valves and Development of Improved Types

The subcommittee on Safety Valves has continued to give consideration to the development of a safety valve that will overcome the objections to the present standard valve which develops a slight leakage before reaching safety valve setting.

Patching of Tanks

The committee has continued its study of this subject but is not ready to submit recommendations due to the many factors involved.

Reduction in Thickness of Interior Compartment Heads

The Interstate Commerce Commission, on the recommendation of your committee, has modified its container specifications to permit the use of interior compartment heads 1/8 in. less in thickness than is required for exterior tank heads.

Safety Valves for Class 105A Series Tanks

Agreement has been reached with the Chlorine Institute, Inc. whereby they will collaborate in formulating a procedure to be followed in testing safety valves for chlorine tank cars.

A communication has been addressed to the American Petroleum Institute with a view of having that organization enter a similar agreement regarding safety valves for Class 105A series tanks used for the transportation of liquified petroleum gases.

Failures of Tank Car Tanks

Within the past few months there have been two unfortunate accidents with tank cars carrying chlorine. The committee promptly arranged for a complete investigation and are being assisted by the tank car owners. Investigations have not yet been completed.

The report was signed by G. S. Goodwin (chairman), assistant to general superintendent motive power, C.R.I. & P.; F. A. Isaacson (vice-chairman), engineer car construction, A.T. & S.F.; A. G. Trumbull, chief mechanical engineer, C. & O.; G. McCormick, general superintendent motive power, Sou. Pac.; W. C. Lindner, chief car inspector, Pennsylvania System; A. E. Smith, vice-president, Union Tank Car Co.; G. E. Tiley, supervisor tank car equipment, General Chemical Co.; C. C. Meadows, master car builder, Tide Water Oil Co.; G. A. Young, head, School of Mechanical Engineering, Purdue University; F. Zeleny, engineer of tests, C. B. & Q., and W. C. Steffa, transportation manager, Sinclair Refining Co.

Action. The report was accepted and the committee instructed to continue its activities during the coming year.

Lubrication of Cars and Locomotives

During the past year this committee continued its study of lubrication practices and problems. In accord with recommendation made last year, after conference with the Committee on Specifications for Materials; specifications for "All-Year Service Car Oil" were submitted to letter ballot and adopted as recommended practice.

Further study of specifications of "Summer," "Winter" and "All-Year Car Oils" has been undertaken by joint sub-committee composed of members from Specification committee, Lubrication committee and representatives from oil producers and further revision made which will be included in the report of the Committee on Specifications for Materials.

Hot Box Records—Review of hot box mileage records, 1929 to 1933 inclusive, shows continued improvement. During the unusually severe weather of the past winter in the Eastern section, there was an increase in the number of hot boxes on both passenger and freight cars as compared with the previous year. This increase was due mainly to packing waste freezing to journals and rolling. Waste rolling was caused chiefly by water in the packing, use of unsuitable car oils and in many cases by the use as free oil of distillates and fuel oils as "cut back."

Cut Back Oil—The indiscriminate use of kerosene, distillate and fuel oils with high congealing points for free oil, with consequent harmful effects has been so noticeable that this committee recommended that the Committee on Specifications be requested to draw up a suitable specification for "Cut Back Oil"; this specification to be made a part of A.R.A. Manual as a standard.

Specifications Reclaimed Car Oil—In accord with request of joint subcommittee of the Committee on Specifications for Materials and Committee on Lubrication of Cars and Locomotives at the meeting held February 13, 1934, that this Committee review specifications for "Reclaimed Car Oil," the following recommendations were made:

"Viscosity limits for reclaimed car oil be established; minimum, 210 deg. F.—40 seconds; maximum, 100 deg. F.—450 seconds."

Present paragraph 7 reading: "Oil must be bright and clean and free from any extraneous solids that will not pass through a number 325 mesh screen," be eliminated from specification as unnecessary.

No change be made in methods of analysis until such time as suitable methods are developed by A.S.T.M. in accord with action taken by joint subcommittee at meeting held November 15, 1933.

Journal Bearings with Cracked Linings—The continuing in service of journal bearings with cracked linings has been given further study. Journal bearings under test have continued in service with cracked linings and are still running after 66,000 miles in passenger service and after 11,000 miles in freight service since the cracks developed.

This committee feels that a great number of serviceable journal bearings are being scrapped unnecessarily due to hair line cracks in lining and that where linings are not loose, as determined by hammer test, such journal bearings should be continued in service.

Journal Bearings—It is the general practice to, (1) apply new journal bearings to foreign cars when wheels are changed on account owners' responsibility, and (2) apply secondhand bearings when wheels are changed on account handling line responsibility, irrespective of the condition of the journal bearings removed which this committee feels is a wasteful practice.

The committee recommends that "when changing wheels, journal bearings shall be carefully examined and reused if bearings have proper crown fit and are not defective."

Methods of Lubrication—Notwithstanding the improvements made during the past several years in quality of car oils, both new and reclaimed, and the better attention given to journals, bearings, wedges, boxes, lids, and dust guards, with the result that journal heating failures have been greatly reduced, it is the feeling of this committee that the objectives sought in train operation will not be attained until a method more effective than waste as a lubricating medium, is found.

To that end this committee recommends that action be taken under supervision of the Director of Research to develop a method that is more satisfactory than the conventional waste lubricating practice.

There are now in use several devices which have been successfully tested in service on a number of roads and it is the opinion of this committee that official tests will result in marked improvement over the present antiquated method of car journal lubrication.

Specifications for Dust Guards—As the result of service tests of various types of dust guards the committee recommends that the present specifications, Dust Guards, be changed to read as follows:

Section 5, second sentence: "A wood dust guard to meet these specifications must not be less than three-ply laminated and secured by use of water resisting glue, or wire bound sections with alternating grain vertical at sides and horizontal at top and bottom."

A.R.A. Rule 66—The committee recommend the following changes in Interchange Rule 66: Add new sentence to Section (g) "When all boxes are repacked due to change of wheels, regardless of responsibility, the stenciling as required under Section (c) be changed." Also, provision should be made for charge for change of stencil.

Present Section (h) be changed to read: "No charge shall be made for repacking, etc., unless all boxes are repacked and the work complete in all details, has been performed; or if oil *and waste* used does not meet A.R.A. specifications in all details."

Present Section (J) item 3 be changed to read: "When lining is loose or *section broken out.*"

Present Section 10, Paragraph (a) heading be changed to read: "Back Roll *when used* — "

Present Section 11, second paragraph changed to read: "Relined bearings must conform to Specifications for Relined Journal Bearings as shown in A.R.A. Manual Section A." Third paragraph changed to read: "Under no circumstances, is it permissible

to use sand paper, emery paper or emery cloth, for the purpose of removing irregularities from the bearing surface. If necessary, a half-round file or scrape may be used. Journal bearings having lining loose, broken, spread over the side or worn to the brass shall be renewed."

Present Section 12, add new sentence "The use of hollow back or corrugated back wedges is not permitted."

With a view of further improving mechanical conditions this committee appointed a subcommittee to work in conjunction with subcommittee appointed by Committee on Car Construction on "The Tolerances in Whole Axle and Journal Assembly." This joint committee has no report to make at this time.

Locomotive Lubrication—The subcommittee appointed to act with similar committee from Committee on Locomotive Construction has no report to make.

The report was signed by G. W. Ditmore (chairman), master car builder, D. & H.; P. Maddox, superintendent car department, C. & O.; G. C. Hirsch, mechanical inspector, N. Y. C.; E. Von Bergen, general air brake, lubricating and car heating engineer, Ill. Cen.; E. C. Cromwell, lubrication supervisor, B. & O., and H. P. Allstrand, principal assistant superintendent motive power and machinery, C. & N. W.

Discussion.—In connection with several new lubricating methods designed to afford improvement over the present conventional waste lubricating practice, the committee was instructed to develop a program of test procedure with an estimate of probable cost and report back to the General Committee.

Action.—The report was received and ordered submitted to letter ballot.

Report on Specifications For Materials

The committee submitted a report involving recommendations for revision of specifications on galvanized sheets, rivets and rivet steel, steel tires, new car oil, reclaimed oil and axles. It was recommended that the following specifications be removed from the Manual because they represent special materials on which there is no agreement among the railroads and which it appears to be desirable to permit purchase of under individual specifications:

Forgings, Alloy Steel, Quenched and Tempered—p. 17.
Fire Hose—p. 86-I.
Cylinders and Cylinder Parts, Cast Iron—p. 69.
Foundry Pig Iron—p. 99.
Welding Wire—p. 291.

Revisions to Specifications

Galvanized Sheets.—The weights shown in Table 1 on page 75 of the Manual should be corrected as follows:

Gage No.	Weight Minimum	Weight Maximum
18	33.3	35.7
20	25.6	27.4
22	21.7	23.3

Par. 10. Change to read as follows: "10. Weight. The average weight per square foot of the galvanized sheets as determined by the weighing of lots not less than 6,000 lb., shall conform to the requirements specified in Table 1, which are based on a maximum variation from the nominal weight of 5 per cent for gages 8 to 16 inclusive; 3½ per cent for gages 18 to 22 inclusive; and 2½ per cent for gages lighter than 22.

REASON—This change is for the purpose of bringing the specifications into agreement with usual manufacturing practice.

Rivet Steel and Rivets.—It was recommended that the reference on page 189 of the Manual to Rivet Steel and Rivets for steam boilers and other pressure vessels should be changed as follows:

Change Par. 2. Process, which now reads, "The steel shall be made by the open-hearth process." to read as follows: "2 Process. (a) The steel shall be made by the open-hearth process. (b) All rivet heads shall be hot formed."

Par. 11. Permissible Variations. Make the present paragraph (a), and add a new paragraph (b), reading as follows: "(b) The shape of rivet heads shall conform to purchasers' specifications. Heads should be formed with a distinct radius, about 1/16 in., between head and shank."

Tires, Steel—Locomotives and Cars.—It was recommended that the reference to steel tires for locomotives and cars on page 257 of the Manual should be changed to read:

Par. 3. Chemical composition. Change the carbon range to read:

"Carbon	Per cent
Class A	0.50—0.65
Class B	0.60—0.75
Class C	0.70—0.85"

Par. 11. Permissible Variations. Change Par. (d) Width of Tire, which now reads: "The width of tire shall not vary more than 1/8 in. over nor more than 1/16 in. under that specified," to read: "(d) Width of Tire. The width of tire shall not be less, but may be 3/16 in. over that specified."

New Car Oil.—The specification for new car oil appearing on page 339 of the Manual was recommended to be revised in accordance with recommendations of the Committee on Lubrication, and, after joint conference with representatives of the oil companies relating to certain changes in the requirements for summer and winter car oils to bring these into line with present-day practice, new requirements for an all-year car oil were added. The recommended specifications follow:

	Summer Car Oil	Winter Car Oil	All Year Car Oil
Flash—Min.	300 deg.	300 deg.	300 deg.
Saybolt viscosity:			
At 210 deg.—Min. desired			50 sec.
At 210 deg.—Min. permitted	55 sec.	40 sec.	47 sec.
At 100 deg.—Max. desired	450 sec.	260 sec.	
At 100 deg.—Max. permitted	725 sec.	300 sec.	300 sec.
Maximum pour point test—Max.	20 deg.	0 deg.	0 deg.
Water—Max.	0.10 per cent	0.10 per cent	0.10 per cent
Tarry matter—Max.	0.10 per cent	0.10 per cent	0.10 per cent
Insoluble impurities (dirt)—Max.	0.10 per cent	0.10 per cent	0.10 per cent

Any material used for blending, when subjected to a distillation according to A.S.T.M. gas-oil method, must show not more than 5 per cent distilling below 500 deg. F.

The methods to be used in determining the above are as follows:

Flash	A.S.T.M. Method D-92-33
Saybolt viscosity	A.S.T.M. Method D-88-33
Water	A.S.T.M. Method D-95-30
Maximum pour point test	A.S.T.M. Method D-97-33

TEST FOR TARRY MATTER AND INSOLUBLE IMPURITIES (DIRT)

Before weighing out the individual portions for the tests, hold a portion of the violently shaken sample at a temperature of about 212 deg. F. for two hours and shake frequently during the time. Weigh 5 grams of oil into a 200 to 300 c.c. Erlenmyer flask. Add 100 c.c. of A.S.T.M. Standard precipitation naptha (A.S.T.M. D-91-29T). (If the sample weighed out differs markedly from 5 grams, use 20 c.c. of precipitation naptha per gram.) Stopper and swirl repeatedly until the oil is dissolved and the solution is homogeneous. Let stand exactly one hour thereafter at room temperature. Filter on a Gooch crucible, keeping the crucible closely covered to prevent creeping. Wash with more of the same precipitation naptha.

Next put 25 c.c. of redistilled chloroform into the flask and dissolve all the tar therein. Pour the solution on the same crucible and receive the filtrate in a weighed 250 c.c. beaker. Continue washing the crucible with the rinsings on the flask and wash further until the crucible is free from tar and the washings run through colorless. Evaporate the chloroform solution to dryness, lay beaker on its side in oven at 212-221 deg. F., dry for one hour, cool and weigh.

To determine miscellaneous dirt in the oil, the first filtration should be on a weighed Gooch crucible and all of the residue must be brought on to the crucible during the treatment with chloroform. Use a policeman if necessary. The matter insoluble in chloroform is miscellaneous dirt.

Weigh the residue plus crucible after drying at 212-221 deg. F. for one hour. Calculate percentage by weight for both determinations.

Lead soaps will not be considered insoluble impurities.

Reclaimed Oil.—Recommendations were made for the following changes to be made in the specifications for reclaimed oil appearing on page 86-G of the Manual. These revisions were suggested on recommendation of the Committee on Lubrication to include viscosity limits and reference to the use of cut-back oil. The recommended changes follow:

Change title to read "Reclaimed Car Oil."

Par. 3. Viscosity, which now reads "The viscosity shall be within the same range as the range specified between new summer car oil and new winter car oil, as adopted by A.R.A. as standard practice," change to read as follows: "3. Viscosity. Saybolt viscosity shall be 40 sec. minimum at 210 deg. F. and 450 sec. maximum at 100 deg. F."

Par. 7, which now reads "Oil must be bright and clean and free from any extraneous solids that will not pass through a No. 325 mesh screen," change to read: "7. Oil must be clean and free from any extraneous solids that will not pass through a No. 325 mesh screen." The only change made is to eliminate

the words "bright and." The committee agreed with the Lubrication Committee in regard to this elimination, but did not agree with them that the entire paragraph should be eliminated, as it has some value for control over cleanliness.

Add a new Par. 8, reading as follows: "8. Blending. Oil used for blending reclaimed oil shall be a suitable lubricating oil which will produce a finished product that meets the above requirements. Oils used for this purpose, when subjected to a distillation test in accordance wiht A.S.T.M. Gas-Oil Method, shall show not more than 5 per cent distilling below 500 deg. F."

The report was signed by F. M. Waring (chairman), engineer of tests, Pennsylvania System; T. D. Sedwick (vice-chairman), engineer of tests, C. R. I. & P.; C. P. Van Gundy, engineer of tests, B. & O.; F. Zeleny, engineer of tests, C. B. & Q.; H. G. Burnham, engineer of tests, Northern Pacific; J. C. Ramage, engineer of tests, Southern; H. W. Faus, engineer of tests, N. Y. C.; E. E. Chapman, engineer of tests, A. T. & S. F.; A. G. Hoppe, engineer of tests, C. M. St. P. & P.; H. P. Hass, engineer of tests, N. Y. N. H. & H., and J. R. Jackson, engineer of tests, Missouri Pacific.

Action.—After considerable discussion, that section of the report containing specifications for reclaimed oils was ordered withdrawn from the report. The report was then accepted and necessary items referred to letter ballot.

Automatic Train-Line Connectors

The investigation of automatic train line connectors has been continued in the laboratories of Purdue University during the past year. Reference is here made to previous reports which give the progress made in this investigation up to June 1, 1933. Plans and specifications have been submitted by 51 companies or individuals who are manufacturers or patentees of these devices. Nine connectors were selected as representative of the various types; such as coupler supported, car-body supported, wing type or pin and funnel type gathering devices, butt face ports, 45 deg. ports or side ports. Six freight and six passenger type connectors of each design were ordered for laboratory tests.

At the time of the 1933 meeting six of the nine freight connectors and three of the nine passenger connectors had been delivered and submitted to laboratory tests. These connectors, which had been tested at that time, were as follows:

Freight Type Connector	*Passenger Type Connector*
Robinson wing type	Robinson wing type
Robinson ball & funnel type	Robinson ball & funnel type
American type	American type
National type	
Roberts type	
Johnson type	

The three freight connectors which had been ordered but not delivered by June 1, 1933 were the Workman-Robinson, Cobb, and MacTaggart. The six passenger connectors ordered but not delivered by June 1, 1933 were the National, Roberts, Johnson, Workman-Robinson, Cobb, and MacTaggart.

At the meeting last year it was decided that no more automatic train line connectors would be received for tests after January 1, 1934, and also that the train line connector test should be limited to connectors which can be used with the present coupler and draft rigging, and should not include devices which involve the design of a new coupler. In October last year the Automatic Train Pipe Connector Company (MacTaggart connector) requested an extension of the limiting date for delivery of their connector to either March 1 or April 1, 1934. The order was placed with this company for connectors in 1931. This request was submitted to the General Committee and it was decided to re-affirm the action taken that all connectors to be included in the test must be delivered on or before January 1, 1934.

During December, 1933, the Johnson passenger type connector, the Roberts passenger type connector, and the Cobb freight and passenger type connectors were delivered for test. The Johnson passenger connector was installed first, and after a few preliminary tests, the official tests were started on January 16, 1934 and completed during April 1934. During this period tests were made with a Johnson passenger connector on one car and the Johnson freight connector installed on the other car, in addition to tests made with the Johnson passenger connector on both cars.

Following the completion of these tests both racks were prepared for the tests on the Roberts passenger connector. Official tests on this device will be possibly started early in June. Upon completion of the tests with the Roberts passenger connector the Cobb connector will be installed and tested.

The joint committee progress report was signed by H. A. Johnson, director of research, A.R.A.

Report on Car Construction

In addition to the previously released subcommittee reports on extensometer and deflectometer and impact test of box cars and the progress report on trucks and truck springs the Committee submitted the following report.

Standard Box Car

Construction of Sample Cars. Construction of the five sample steel-sheathed wood-lined box cars of 50 tons nominal capacity was completed in September, 1933.

Extensometer and Deflectometer Tests. The extensometer and deflectometer tests of the new standard design were completed the latter part of November, 1933. These results were compared with previous tests of the same character made in 1931 of the tentative A.R.A. design first submitted in 1923 and the U.S.R.A. design first produced in 1919. A complete and comprehensive report with conclusions has been issued. It is not the purpose of this statement to discuss the results and conclusions which are fully covered by the report, but it may be said that the new standard car is stressed lower and more uniformly in its essential members than either of the other two designs even though for equivalent size and capacity it is some 3,500 lb. lighter and some sections are smaller. This includes the center sill member.

Impact Tests. Following the extensometer and deflectometer tests two of the new standard cars were subjected to a series of impact tests which were carried well beyond collision conditions under full axle loads in comparison with similar tests made at the same time of the tentative A.R.A. and U.S.R.A. designs. Complete and comprehensive report on the tests of all three types of cars has been issued.

The A.R.A. standard cars demonstrated their capacity to absorb abnormal collision punishment under full axle load without damage of consequence, whereas both the U.S.R.A. and the tentative A.R.A. design car body structures showed unmistakable evidence of approaching failure under somewhat less punishment. Furthermore, the test showed clearly that although a different design, cross sectional area and weight of center sill member is used in each of the three designs, any one of them may be relied upon to survive disintegration of the respective superstructures and related underframe constructions under collision conditions leading to destruction of the cars.

Operation in Regular Service. At the conclusion of the impact tests the two A.R.A. standard cars used were reconditioned as necessary and assigned to member roads for regular revenue service. The three standard cars not required for these tests had already been assigned to regular service. Current reports are being made by the roads in whose service the cars are operating and any information of value accumulated will be made available.

Cost Comparison. In January of this year an inquiry for bids on the three significant designs of steel-sheathed wood-lined box cars was formulated and released to the A.R.C.I. through A.R.A. executive channels. This was based on cars of the same inside dimensions, trucks and other specialties so that the prices received as requested for lots of 2,000 and 5,000 cars each would be strictly comparable. The bids received show that the new standard A.R.A. car may be purchased for $100 less each than for the U.S.R.A. design and $50 less each than for the tentative A.R.A. car and weighs light approximately 3,500 lb. less than either of the other two designs on the basis of the same cubic capacity, in each case.

This statement includes also certain information as to what this reduced weight and cost is worth per car to the roads annually and over an assumed useful life period of 25 years.

Revision of Standard Box Car Drawings. Under date of June 12, 1934, A.R.A. Circular DV-817 was issued to cover "Revision of Appendix 'A' to Circular DV-768 dated June, 1932, and Revision of Drawings for Standard Steel-Sheathed Wood-Lined Box Car 40 and 50 Tons Nominal Capacity." The drawings have been revised accordingly for incorporation in the Manual to show changes based on experience gained during the construction of the five sample cars and as a result of the extensometer, deflectometer and impact tests previously discussed.

Construction of Rolls for the Four New Sections. This has been arranged for through A.R.A. executive channels and the work is rapidly nearing completion on rolls for the new "Z" bar center sill and side post sections, the base "W" section side plate and the alternate "Z" bar side plate.

Completion of the Work. The above outlined activities complete the program of procedure under which A.R.A. standard cars may be produced, and the design, construction and test of the standard steel-sheathed wood-lined box car developed there-

under for unrestricted general interchange service.

Self-Clearing Hopper Cars

In the report last year, statement was made that your committee, in co-operation with the A.R.C.I., was proceeding with designs of 70 and 50 tons nominal capacity self-clearing hopper cars. The final drawings are now nearing completion. Thereafter it will be necessary to formulate a specification and description which it is proposed to release under special letter ballot as early as practicable.

As soon as drawings for the base car are completed, it is planned to release them in accordance with the previously approved program, to certain specialty manufacturers for the preparation of alternate designs incorporating (a) integral cast-steel underframe and hopper construction complete, and (b) certain parts such as bolsters, interior braces and hopper door frames in cast steel.

Center Sill and Related Hopper Construction. The center sill construction will consist of continuous "Z" bar members of the same design as used on the standard box car, except for increase of approximately 20 per cent in net cross sectional area to offset the effects of corrosion which might develop to a greater extent than would be present in the center sills of a box car, as the result of defective floor, hopper and hood sheets.

This is the only important construction item on which any difference of opinion continued within the committee during the progress of the work, consequently it was decided to prepare drawings covering both base and alternate arrangements. The base construction, favored by the majority, will provide for application of center sill members without coping in the bottom horizontal flanges and with hopper construction arranged to suit. As a partial offset to the advantages offered by this arrangement, it is necessary to use therewith hoppers of somewhat reduced cubic capacity and door opening width.

The alternate arrangement will be of the same general design except that the bottom horizontal flanges will be coped out continuously throughout the hopper zone and reinforced with continuous compensating angles applied to the inside faces of the "Z" bar members. This results in less unused space under the center sill, about 5.5 cu. ft. additional hopper capacity for the 70-ton car and door openings of 3 in. greater width each. The offsetting disadvantages are slightly greater initial cost and weight, however, the ratio of light weight to cubic capacity remains the same as in the base arrangement.

It is desired to emphasize, however, that both base and alternate designs incorporate the new and improved features of center sill construction as used in the box car, i.e., continuous integral member of uniform cross sectional area without separate cover plate from end to end of car, improved and substantially applied bolster center filler castings and standard space for draft gear and attachments without coping or application of reinforcing angles at the draft sills.

Refrigerator Car

In the report last year your committee advised that work on this design was being held in abeyance until after completion and test of the standard steel-sheathed box cars and the preparation of standard hopper car designs. However, during the current year the importance of this design was again brought to the attention of your committee and consequently the following action has been taken:

A subcommittee was appointed and a questionnaire circulated to develop preliminary information on the basic features, arrangement and characteristics of a car which would best meet requirements of traffic. As soon as the replies are received and tabulated, a meeting of the subcommittee will be held to analyze the results and formulate plans leading to actual design work in co-operation with the A.R.C.I.

Equipment Clearances and Maximum Outline

The enlarged equipment clearance diagram adopted as standard by the Engineering Division at this year's annual meeting does not incorporate certain important changes affecting design and operation of equipment, therefore is not acceptable in its present form as a limiting outline for design of equipment for general interchange service. This matter is being followed up in co-operation with the Engineering Division with a view to making satisfactory disposition of all unsettled questions.

Truck Springs

Non-Harmonic Spring Devices. During the past year a program was formulated for testing the various devices, spring groups and complete trucks, intended to minimize harmonic spring action for the protection of lading and to reduce the dynamic forces set up within car structures and trucks. The tests were completed and a progress report showing the results has been issued. Both laboratory and service endurance tests are now being made and reports thereon will be submitted as soon as the field work is completed and analyzed. [An abstract of the progress report is given at the end of this report.—Editor.]

Helical Spring Groups

Helical Spring Groups. Further design work on this item, including springs for 100-ton nominal capacity trucks, referred to last year, is being held in abeyance pending additional study and analysis of the test results for this type of spring of both present and former A.R.A. standard designs.

Truck Spring Planks

In the last report your committee referred to difficulties experienced account failure of truck spring planks. During the past year a subcommittee was appointed to co-operate with the truck manufacturers' Engineers Committee in the study of this problem. Progress is being made but no definite recommendations can be submitted at this time.

Rail Motor Car Axles

Chronological review of the situation with respect to designs of axles for rail motor cars was included in the 1933 report. Further developments during the past year are summarized in what follows:

The Rolling Stock Committee No. 1 of the American Transit Engineering Association has now made final and complete report with recommendations as shown in the 1933 Supplement to the Engineering Manual published by the American Transit Association under Manual Section E 3-33 covering "Design of Axles for Electric Railway Motors." These recommendations have the approval of A.T.E.A. and also of the A.T.A.

Axle material specifications of the American Transit Engineering Association will be checked against present A.R.A. specifications and specifications for passenger car axles now in force on a number of roads and as soon as complete information is assembled, it is proposed to submit by special Letter Ballot.

Standard Center Plate

In the 1933 report attention was directed to the fact that a center plate having nominal diameter of 12 in. with corresponding bearing area is the present A.R.A. standard for 2-C, 2-D and 2-E trucks regardless of the differences in load carrying capacities; further, that the question of whether or not this diameter should be increased for cars of 140,000 lb. nominal capacity with a view to reducing the unit bearing pressure was being studied, consideration being given to the effect on resistance to swiveling of truck and wear on wheel flanges and other parts. As a result of further studies and replies received to questionnaire your committee is including in the design for the new standard 70-ton nominal capacity hopper car, a center plate having diameter increased from 12 in. to 14 in.

It is recommended that the 14 in. diameter center plate be made standard for future cars of 140,000 lb. nominal capacity and it is the intention that if the new 70-ton nominal capacity hopper car is approved to submit to letter ballot, item of center plate diameter increase for all future cars of this capacity.

Geared Hand Brake

The subcommittee appointed last year has made progress on the standardization of basic features of design, application and operation of geared hand brakes with a view to bringing about uniform practice. This subject will be pursued during the coming year in co-operation with the Committees on Brakes and Brake Equipment and Safety Appliances and also as necessary with the hand brake manufacturers.

Condensation in Box Cars

During the past year a subcommittee has conducted a series of tests and observations with four steel-sheathed wood-lined box cars of the same design equipped with steel roofs and fitted up as follows:

P.R.R. 100,176—Plain painted steel ceiling.
P.R.R. 100,237—Ceiling repainted and sprayed wet with ground cork.
P.R.R. 100,016—Ceiling one-half of car (A end) covered with Johns-Manville insulating board. Other half of ceiling covered with Insulite board.
P.R.R. 100,285—Ceiling lined with ⅛ in. x 3¼ in. tongue and groove pine, dressed on one side only, rough side down.

These cars have been operated together at all times in the same territories and consequently under exactly the same conditions and much valuable information has been developed.

This is an involved subject which will require further study and research in order that conclusions may be reached, including the question of economies. The committee, therefore will be continued and the co-operation of the Freight Claims Division

will be arranged for. As soon as practicable a conference will be held with the Director of Research, attended by your subcommittee and representatives of the Freight Claim Division for formulating further program of investigation and tests.

Treatment of Lumber for Car Construction

A subcommittee has been appointed to co-operate with the American Wood Preservers' Association. This will include study of questionnaire sent out by the American Wood Preservers' Association. No meeting has been held.

Letter Ballot Items

It is recommended that the following items be submitted to letter ballot:

Designating Letters for Cars. The following changes in definitions and designation for cars are recommended: Class R, refrigerator cars change definition for Classes RC and RPA and add new Class RPB; Class T, tank cars, add new Class TGB; Class P, passenger cars, add new Class PL.

RC—Solid Carbon Dioxide Refrigerator. A house car with or without ventilation, heavily insulated at floor. Sides and ends heavily insulated either full height or to height approximately of maximum load, with insulated cross partitions forming compartments. With or without blankets of suitable insulating material placed over top of load in each compartment. With or without gravity conveyors for loading and unloading. Designed primarily for the transportation of solid carbon dioxide.

RPA—Mechanical Refrigerator. A house car equipped with insulation, with or without means of ventilation and provided with apparatus or other device for furnishing protection against heat and/or cold. Apparatus operated by direct mechanical drive from car axle.

RPB—Mechanical Refrigerator. A house car equipped with insulation, with or without means of ventilation and provided with apparatus or other device for furnishing protection against heat and/or cold. Apparatus operated by electro-mechanical drive from car-axle.

TGB—A car equipped with two cylindrical insulated metal tanks, with or without special interior lining, with cab located between tanks for protecting loading and unloading devices of each tank. Car suitable for transportation of beverages, etc., in bulk.

PL—Lounge Car. For first class passenger service and of a more luxurious character than a day coach with or without smoking compartment with upholstered movable chairs, settees, etc., and other facilities and conveniences to provide comfort for passengers.

Splicing Freight Car Center Sills

Attention of the committee has been called to the lack of information in the Code of Interchange Rules regarding method of splicing so-called "fish-belly" center sills on a large number of cars in service. The Code of Rules now covers splicing of A.R.A. center sills, and various wooden sills, but does not contain information pertaining to the built-up fish belly type. The committee has prepared drawings showing the splicing of this type of center sill, and has written up the changes necessary in Interchange Rule 22, and recommends that they be referred to letter ballot for adoption as Standard.

Proposed Modification of Interchange Rule 22. Change Sections (6), (7), (8) and (9) of Interchange Rule 22 to Sections (9), (10), (11) and (12), and insert the following new Sections (6), (7) and (8): "(6) *Center Sill Splice for Cars Having Steel Sills Built Up of Plates and Angles. Fig. 13-D*—Splice to be located back of body bolster and as near to bolster as rivet spacing in sill permits applying the number of rivets specified.

Splice shall be butt-joint type.

Adjacent center sill may be spliced.

The splice plates shall be at least as thick as web plate of sill, but not less than 5/16 in. thick plates shall be used and should not be more than 24 in. long, unless spacing of rivets in top and bottom chord are so great that longer plate may be required to apply the required number of rivets.

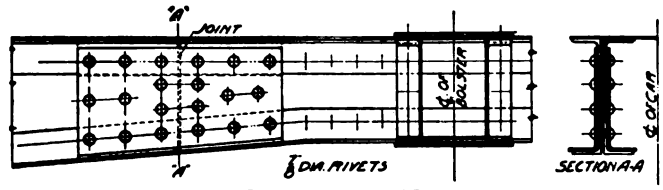
Should center sill cover plate be broken, splice plate of same thickness and width as cover plate now on car and of length to take at least four rivets in each sill and each side of joint to be applied. At each end of this plate, between sills, two rivets to be applied. All rivets through cover plate should be of same size as now in cover plate.

(7) *Center Sill Splice for Cars Having Steel Sills Built Up of Plates and Angles. Fig. 13-E.*—Splices shall be butt joint type. This type of splice to be used at the sloping portion of center sill when the depth of sill at fracture is not more than 16 in. Adjacent center sill may be spliced. Types 1, 2 and 3 illustrate the application of splice plates to sills having the following members broken:

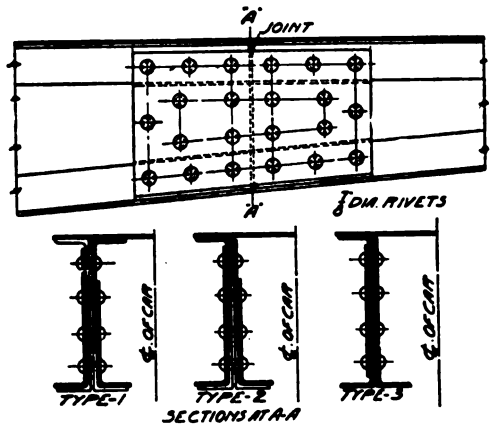
Type 1: This type of splice to be followed when top angle, web plate and one or both bottom angles are broken. The flanged plates to be at least of same thickness and flanges of same width as angles now on car end, but not less than 3/8 in. thick, each plate.

Type 2: This type of splice to be followed when web plate or one or both bottom angles are broken. Size of flanged plates to be the same as specified under application for Type 1.

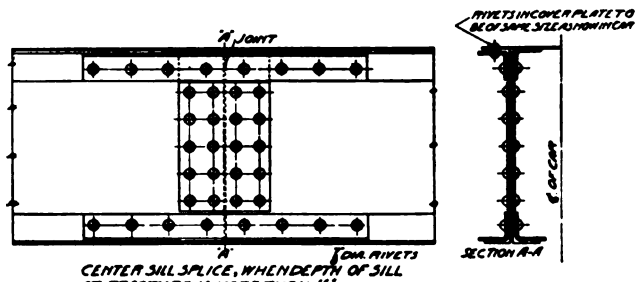
Type 3: This type of splice to be followed when web plate only is broken. Thickness of each splice plate to be at least



CENTER SILL SPLICE BACK OF BOLSTER
FIG. 13-D



CENTER SILL SPLICE, WHEN DEPTH OF SILL AT FRACTURE IS NOT MORE THEN 16"
FIG. 13-E



CENTER SILL SPLICE, WHEN DEPTH OF SILL AT FRACTURE IS MORE THEN 16"
FIG. 13-F

Recommended methods of splicing center sills of "fish belly" type

as thick as web plate now on car, but not to be less than 3/8 in. thick. Should center sill cover plate also be broken, this plate should be spliced in same manner as specified for Fig. 13-D.

(8) *Center Sill Splice for Cars Having Steel Sills Built Up of Plates and Angles. Fig. 13-F.*—This type of splice to be used when depth of sill at fracture or joint is more than 16 in.

Adjacent sill may be spliced.

The flanged or rolled angles to be at least the same thickness, and legs to be at least same width as angle now on car.

Web splice plates should be at least as thick as web in car, but should not be less than 3/8 in. thick each plate.

The spacing of rivets in web splice plates should be not more than 4 in., nor less than 2¼ in.

Should center sill cover plate also be broken this plate should be spliced in same manner as specified for Fig. 13-D."

Fundamentals of Car Design

It is recommended that item 8, Fundamentals of Car Design, Section C, Manual be modified in accordance with proposed form shown below, to clarify the intent. "8. Side bearing clearance shall be adjusted within the limits of 1/8 in. to 1/4 in. per bearing

and shall be measured at each bearing with car on level tangent track with car body level. Total side bearing clearance at BR and AL corners must be made the same as total clearance at BL and AR corners with permissible variation not to exceed ⅛ in.

Journal Bearing Wedges

To eliminate difficulties reported on account of the use of journal bearing wedges having lightening cores or recesses, it is recommended that the note appearing on drawing, page 25, Section D of the Manual of Standard and Recommended Practice, be revised to read "Wedges shall be of forged or cast steel *and solid without lightening cores or recesses.*"

Platform Height for Passenger Car

Recommended Practice. In the interests of standardization and interchange of passenger cars, it is recommended that the height from rail to top of platform for new passenger car equipment shall be 50⅝ in., based on coupled height of 34½ in.

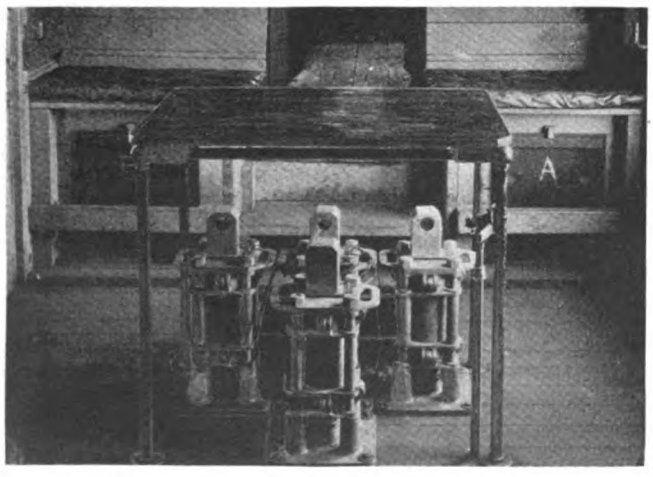
The report was signed by P. W. Kiefer (chairman), chief engineer motive power and rolling stock, N. Y. C.; T. P. Irving (vice-chairman), engineer car construction, C. & O.; W. A. Newman, chief mechanical engineer, Can. Pac.; A. H. Fetters, general mechanical engineer, U. P.; J. McMullen, superintendent car department, Erie; F. A. Isaacson, engineer car construction, A. T. & S. F.; G. S. Goodwin, assistant to general superintendent motive power, C. R. I. & P.; H. L. Holland, assistant engineer, B. & O.; E. B. Dailey, engineer car construction, So. Pac.; B. S. Brown, general foreman, Pennsylvania System; K. F. Nystrom, superintendent car department, C. M. St. P. & P., and J. P. Laux, superintendent motive power, L. V.

Discussion.—In the absence of Chairman Kiefer the report was submitted by E. P. Moses, engineer of rolling stock, New York Central. Particular attention was given in the discussion to the subject of condensation in steel-roof box cars and the subcommittee was instructed to continue its experiments with a view to determining how damage from this cause can be reduced.

Action.—The report was accepted.

Progress Report on Tests of Trucks and Truck Springs*

During the fall of 1933 the Car Construction Committee conducted a series of tests to determine the riding characteristics of existing truck springs and to ascertain to what extent the riding characteristics can be improved by existing devices, variously desginated as friction springs, snubbers and stabilizers, or by special trucks; also, what mechanical characteristics these devices should have for most desirable service performance, with the view of eventually establishing specification requirements. The primary purpose of the investigation is to reduce the damage to lading and to the car equipment caused by vertical oscillation of the truck springs and car body, and it is the opinion of the committee that the riding qualities tests which were made give a true and accurate measure of the ability of the various devices tested to reduce lading damage from vertical oscillation on cars equipped with true wheels and operated at speeds up to 60 m.p.h.



Group of four lading dynamometers in center of test car

Riding-qualities tests were supplemented by laboratory tests, following which the various devices were placed in service under refrigerator cars to obtain information as to their endurance qualities. The purpose of the laboratory work was, first, to secure measurements and performance records of the devices when they were new, which could be used to detect changes in characteristics as they developed in service and, second, to develop, if possible, some satisfactory laboratory test that would be an index of riding qualities. [No information of value with respect to the second objective was developed by the laboratory tests.—EDITOR.]

Devices and Trucks Submitted to Tests.—The tests were limited to one device or one type of truck, or both, from each manufacturer. Two car sets of each device or truck were furnished for use in riding-quality, laboratory and service tests. The devices and trucks submitted to tests are as follows:

SPRING GROUPS FOR 40-TON CAPACITY CARS

1933 standard A.R.A. coil springs, Class C
Old standard A.R.A. coil springs, Class C
Barber friction bolster spring, Type 3
Cardwell friction bolster spring, Type A
Coil-elliptic springs for conventional trucks
Edgewater, Class J-63-K, ring-spring truck spring
Frost friction truck spring
Holland volute spring
Miner truck spring snubber, Class C-2
National car stabilizer, Type F-2-A

SPECIAL TRUCKS FOR 40-TON CAPACITY CARS

Barber stabilized truck
Coil-elliptic springs for double-truss trucks
Goodwin car stabilizer truck
National, Type B, "Coileaf" truck

SPECIAL TRUCKS FOR 50-TON CAPACITY CARS

Pennsylvania—Kiesel truck
Pennsylvania—Young truck

Test Procedure.—A special train consisting of two electric motor cars and two test cars was used in order to make operating conditions as nearly identical as possible for all tests. To provide further assurance that all devices would be compared on an equal basis, two 50-ton box cars, fully equipped for making spring and truck tests, were rented by the A. R. A. from the Symington Company. Each test consisted of making three round trips on a definite schedule of speeds from 30 to 60 m.p.h. between Rochester and Avon, N. Y., on the Erie railroad. Both test cars were equipped with instruments to measure the performance of the truck springs and the riding characteristics.

The test track between Rochester and Avon, a distance of 18.5 miles, was fairly representative of main branch-line track and was laid with 80-lb. and 100-lb. rail of 30 and 33-ft. lengths respectively, with staggered joints. The test track was all single track, with electric operation and with some steam-train service.

Test Cars.—The test cars were from a lot built for the D. L. & W. in 1928. They are representative construction, with steel under-frames, steel ends and steel superstructure frame, and outside wood sheathing, substantially to A.R.A. recommended-practice design for double-sheathed box cars. The light weight (empty) of each car after test equipment was installed was approximately 50,000 lb. The cars were originally equipped with 50-ton trucks, 5½-in. by 10-in. journals, but since most complaints of damage to lading had pertained to 40-ton capacity cars, it was decided to confine the investigation principally to 40-ton equipment and 40-ton trucks were applied to the test cars. New single-plate cast-iron wheels, mounted on axles with 5-in. by 9-in. journals, were used on the test cars. The tread of each wheel was ground true with the journal-bearing surface, using A.R.A. standard taper, and each wheel of a pair was finished to the same tape size.

Throughout the series of tests one car, designated as car *A*, was used for testing the new devices or trucks, while the other, car *B*, was kept as a yardstick, using only the 1933 standard A.R.A. coil springs, Class C, for 40-ton trucks and Class D for 50-ton trucks.

Load.—All devices and trucks submitted were tested under two load conditions; namely, light-load and heavy-load conditions. Under the light-load conditions (40-ton capacity cars), the weight of each car was approximately 85,000 lb. on rail and, under the heavy-load conditions, 135,000 lb. In the riding-qualities tests with the 50-ton capacity trucks, the light-load weight was 105,000 lb. on rail and the heavy-load weight, 168,000 lb. Sand bags and pig iron were used for loading the cars to the desired weight.

Test Instruments.—Four Symington lading dynamometers were installed in the center of each car to measure the effect on

* Abstract of a report submitted by a sub-committee of the Committee on Car Construction.

lading of vertical oscillations or bouncing of the car. Each instrument had a 100-lb. weight supported on a spring, which held the weight against a stop at the top of the frame. The amount of pressure of the weight against the top stop was adjusted by compression of the spring underneath. This was set for some value in excess of the weight and, having four instruments in each car, it was possible to set them at four different values in excess of the 100-lb. weight. With this instrument fastened to the floor of the car the weight is subjected to the dynamic loads imposed by these loads. If the shock is greater than the value for which the spring on an instrument is adjusted, it will cause the weight to leave the top stop, and when it has moved .005 in. from this stop an electric circuit is broken and the event registered on a counter. If a shock causes a registration on all instruments set for values up to 100 per cent in excess of the weight, it means that it would have made the pressure between a piece of lading and the supporting part of the car momentarily increase 100 per cent. This increase in pressure or load is what tears meat from hooks and damages other kinds of lading. Under certain circumstances lading may be lifted from the car floor as a result of these shocks and the impacts following cause severe damage. With the lading dynamometers functioning in this manner it was possible to determine the number of shocks of four different intensities on each car. The electric counters were read at each mile post during every run, which enabled the data to be separated according to different running speeds.

The car *A* lading dynamometers were set for 25, 35, 50 and 75 per cent above gravity during the light-load tests. When making the heavy-load tests and also light-load tests of plain coil springs, the settings on the car *A* instruments were changed to 25, 50, 75 and 125 per cent above gravity. This latter range was used on car *B* (which was always equipped with 1933 A.R.A. coil springs) for all tests except a few at the beginning of the program when the settings were as first given for car *A*. The range of settings used was determined by experience. A value of 25 per cent above gravity was chosen as the minimum because shocks of that intensity do not feel to be particularly damaging, and the maximum value used was such that few or no counts were secured on that instrument. The difference in setting of the instruments in the two cars does not prevent comparison of the shocks occurring in each car, which comparison is made by means of a "lading-damage factor" as explained later.

Each car was also equipped with four Symington bolster movement totalizers, one for each nest of truck springs, to measure the total bolster downward motion during any test run or portion of a run. The other instruments used during the tests included spring deflection gages, speedometer and speed recorder.

Lading-Damage Factor.—The lading-damage factor is an abstract number computed from the data obtained from the lading dynamometers for the purpose of comparing the overall performance of each device or truck submitted with the performance of the 1933 A.R.A. standard coil springs. The lading-damage factor submerges the identity of the individual shocks and gives an index of the riding qualities of the car for entire test runs.

The lading-damage factor was computed by multiplying the number of shocks of each intensity by an appropriate factor and adding the products. The multiplying factors used are

Table I—Comparative Summary of Lading-Damage Factors—40-Ton Trucks and True Wheels

	85,000 lb. on rail			135,000 lb. on rail		
	Car *A* test device	Car *B* 1933 std. coil springs	Car *A* per cent of Car *B*	Car *A* test device	Car *B* 1933 std. coil springs	Car *A* per cent of Car *B*
1933 std. A.R.A. coil springs, Class C	(Not comparable account low speeds)			5,637	6,686	84.3
Old std. A.R.A. coil springs, Class C	8,760	18,721	46.8	(Springs went solid at high speed)		
Barber friction truck springs, Type No. 3	5,475	11,319	48.4	(Retaining bolt broke during test, rendering device inoperative)		
Cardwell friction bolster spring, Type A	1,076	19,538	5.5	677	6,683	10.1
Coil-elliptic springs for conventional trucks	748	21,608	3.5	501	7,045	7.1
Edgewater ring spring truck spring, J-63-K	3,115	16,985	18.3	1,792	7,313	24.5
Frost friction truck spring	10,059	20,389	49.3	4,185	6,701	62.5
Holland volute spring	1,449	17,620	8.3	(Springs went solid at high speed)		
Miner truck spring snubber—Class C-2	2,978	21,660	13.7	1,323	5,428	24.4
National car stabilizer, Type F-2-A	1,172	27,056	4.4	800	6,735	11.9
Barber stabilized truck	901	15,211	5.9	1,170	6,779	17.2
Coil-elliptic springs for double-truss trucks	630	16,796	3.8	283	7,091	4.0
Goodwin car stabilizer truck	(not tested)			865	7,475	11.6
National Type B "Coileaf" truck	1,908	19,416	9.8	481	6,500	7.4

Note 1—This summary is based on average results of one round trip of 37 miles, Rochester to Avon and return. The last four devices are special types of trucks. The others are devices for standard trucks.

Note 2—Car *B* was always equipped with 1933 A.R.A. standard coil springs, Class C. The variation in the lading-damage factors for Car *B* was due in part to the variable influence of the stabilizing device on Car *A*. This influence was apparent when couplers of the two cars were under tension.

Note 3—The low-value lading-damage factors indicate smooth-riding qualities and the high-value factors rough-riding qualities. The table is given for matter of information and not intended to be used as a rating. Complete information will not be available until endurance tests are completed.

Table II—Comparative Summary of Lading-Damage Factors—50-Ton Trucks and True Wheels

	105,000 lb. on rail			168,000 lb. on rail		
	Car *A* test device	Car *B* 1933 std. coil springs	Car *A* per cent of Car *B*	Car *A* test device	Car *B* 1933 std. coil springs	Car *A* per cent of Car *B*
Pennsylvania—Kiesel trucks	472	8.367	5.7	675	4,457	15.1
Pennsylvania—Young trucks	131	6,407	2.1	110	4,952	2.3

Note 1—This summary is based on average results of one round trip of 37 miles, Rochester to Avon and return.

Note 2—Car *B* was always equipped with 1933 A.R.A. standard coil springs, Class D. Do not compare lading-damage factors in Table II with those in Table I.

Note 3—See corresponding note under Table I.

the squares of the ratio of the settings for the different instruments, as follows:

Setting of the instrument, per cent	25	35	50	75	125
Setting ratio	1.0	1.4	2.0	3.0	5.0
Multiplying factor	1	2	4	9	25

These factors are empirical and have been chosen from the fact that the shocks are probably in relation to the deflection of the truck springs which produce them. The energy involved in spring deflection is proportional to the square of the deflection, and it is this uncontrolled energy that produces the shocks. From this it is seen that one 125 per cent shock is considered to be 25 times as damaging as one 25 per cent shock. It is felt that this is not an unreasonable assumption.

Results of Riding-Qualities Tests—40-Ton Capacity Trucks and True Wheels.—The tests show that at certain speeds with plain coil springs heavy spring oscillation occurs which, no doubt, would cause heavy damage to lading. The intensity of this spring oscillation and the speed at which it is most severe depends upon the load in the car and the stiffness of the springs.

With the old standard A.R.A. coil springs installed in the trucks, test car *A* rode smoothly up to speeds of approximately 40 m.p.h. with the light load and approximately 36 m.p.h. with the heavy load. As speed was increased above these values vertical oscillation of the car started, it being most violent at a speed of approximately 47 m.p.h. at light load and 41 m.p.h. at heavy load. These speeds at which the action is most violent are called critical speeds, and as speed was further increased above these values the oscillation decreased in violence. At light load the center of the car, where the instruments were located, rode fairly well at speeds above 55 m.p.h., but the ends were not as free from oscillation as the center. At heavy load the oscillation decreased in intensity until a speed of 48 m.p.h. was reached and then it began to increase again. It kept on increasing up to the maximum test speed of 60 m.p.h.

Fig. 122—Summarized Data Cars Loaded To 85,000 Lb. On Rail Average Results For One Round Trip Rochester To Avon

Test Device on Car A in all Cases.
Car B Equipped with 1933 Standard A.R.A. Coil Springs in all Cases.

Device	Individual Vertical Shocks 0.25 g	0.35 g	0.50 g	0.75 g	1.25 g	Total Bolster Motion Downward in.	Maximum Spring Deflection in.
1933 Standard A.R.A. Coil Springs* (Class C)							
Car A	907	612	207	69	..	1949	0.42
Car B	1056	881	650	207	..	1831	0.40
Old Standard A.R.A. Coil Springs (Class C)							
Car A	4669	..	728	131	0	3819	0.66
Car B	4467	..	1732	739	27	2519	0.45
Barber Friction Truck Spring (Type No. 3)							
Car A	2285	1023	259	12	..	3241	0.61
Car B	5408†	..	†	604	19	2493	0.42
Cardwell Friction Bolster Spring (Type A)							
Car A	794	109	16	0	..	1125	0.29
Car B	1684	..	2582	789	17	2326	0.44
Coil-Elliptic Springs for Conventional Trucks							
Car A	608	64	3	0	..	1497	0.48
Car B	1710	614	2251	1074	..	2432	0.40
Edgewater Ring Spring Truck Spring (Class J-63-K)							
Car A	1683	479	114	2	..	1468	0.42
Car B	4002	..	1481	701	30	2514	0.49
Frost Friction Truck Spring							
Car A	2045	1174	845	254	..	2703	0.30
Car B	2289	..	2697	768	16	2484	0.42
Holland Volute Spring (Dwg. FTB-A-119)							
Car A	1065	168	12	0	..	2557	0.64
Car B	4300	..	1646	679	25	2474	0.45
Miner Truck Spring Snubber (Class C-2)							
Car A	1650	399	110	10	..	731	0.14
Car B	1825	919	1914	1149	..	2454	0.41
National Car Stabilizer (Type F-2-A)							
Car A	1030	63	4	0	..	928	0.36
Car B	1680	253	2937	1458	..	2612	0.49

* Variations in results caused by slight difference in critical speed of two cars. Train not operated at high enough speed to exceed critical speed of both cars.
† The 5408 shocks shown under 0.25 g also include the 0.50 g shocks.

and was so violent in the speed range from 50 to 60 m.p.h. that the springs were driven solid.

If the ends of the car oscillate 180 deg. out of phase, the center can be riding smoothly while the ends show considerable roughness. This was observed during heavy load tests of plain coil springs. However, when this condition was discovered there were not sufficient instruments available to place them in the car ends as well as in the center. With devices that do not permit oscillation, this condition does not occur.

Information on the action of car *A* under light load when equipped with 1933 standard A.R.A. coil springs was incomplete because this test was run in the early part of the series and high enough speeds were not attained, but a large amount of data were secured showing the action of these springs on car *B*, which was always equipped with them while car *A* was equipped with the various test devices. The new standard springs have higher critical speeds than the old standard springs and for that reason oscillation does not start as soon as with the old coils, while the speed is being increased. When oscillation does occur, the effect is more damaging than with the old coils. Change in action of car *A* with different test devices had some influence on the action of car *B*, which was mainly a change in the maximum intensity of shock that occurred as a result of vertical oscillation. It had no influence on the location of the critical speed, as this is determined solely by the natural vibration period of the springs as determined by their deflection under the load they carry.

With the 1933 standard A.R.A. coil springs installed the cars rode smoothly up to speeds of approximately 43 m.p.h. with the light load and approximately 38 m.p.h. with the heavy load. Vertical oscillation took place as the speed was increased above these values, the critical speed with the light load being approximately 52 m.p.h. and, with the heavy load, approximately 47 m.p.h. As speed was increased above the critical value, the intensity of oscillation decreased but not so much as with the old standard coils. With the light load it remained fairly high up to 60 m.p.h. and with the heavy load it decreased in the middle of the car but remained high in the ends.

With both the old standard and the 1933 standard coil springs, increasing the load in the car lowered the speed at which the oscillations start and decreased the intensity of the shocks.

The effectiveness of the different test devices in improving riding qualities is shown in Table No. 1. This is given for information and is not intended to be used as a rating. For each device at each test load there is given a lading-damage factor for car *A* and also for car *B* and the percentage which the car *A* figure is of the car *B* figure. The common base on which these lading-damage factors have been computed is one round trip—Rochester to Avon and return—the figure being the average for all trips made with each device, which was three in most cases. Variation in results for car *B* is caused in part by the influence on this car of the different action of car *A* with the different devices. Test conditions were rigidly controlled so as to make results directly comparable. A low value of lading-damage factor indicates smooth-riding qualities and a high value rough-riding qualities. No attempt has been made to set a limit which marks the boundary between smooth and rough-riding qualities.

Results of Riding-Qualities Tests—50-Ton Capacity Trucks and True Wheels.—A series of tests was also made with 50-ton capacity trucks installed under the test cars to determine the riding qualities of the Kiesel and Young 50-ton capacity trucks

Fig. 123—Summarized Data Cars Loaded To 135,000 Lb. On Rail Average Results For One Round Trip—Rochester To Avon

Test Device on Car A in all Cases.
Car B Equipped with 1933 Standard A.R.A. Coil Springs in all Cases.

Device	Individual Vertical Shocks 0.25 g	0.50 g	0.75 g	1.25 g	Total Bolster Motion Downward in.	Maximum Spring Deflection in.
1933 Standard A.R.A. Coil Springs (Class C)						
Car A	2883	603	38	0	2505	0.58
Car B	3527	630	71	0	2524	0.56
Old Standard A.R.A. Coil Springs (Class C)						
Car A	1181	121	9	0	3340	0.84 Lead wire sheared
Car B	3411	590	42	0	2513	0.56
Barber Friction Truck Spring (Type No. 3)						
Car A	947	20	4	0	2634	0.77 Lead wire 0.01 in.
Car B	3639	715	94	2	2549	0.60
Cardwell Friction Bolster Spring (Type A)						
Car A	629	12	0	0	771	0.24
Car B	3468	622	78	1	2502	0.58
Coil-Elliptic Springs for Conventional Trucks						
Car A	465	9	0	0	1150	0.62
Car B	3480	678	92	1	2543	0.61
Edgewater Ring Spring Truck Spring (Class J-63-K)						
Car A	1632	31	4	0	226	0.35
Car B	3684	680	101	0	2560	0.61
Frost Friction Truck Spring						
Car A	2613	312	36	0	1808	0.30
Car B	3418	630	82	1	2551	0.59
Holland Volute Spring* (Dwg. FTB-A-119)						
Car A	306	38	23	0	2133	0.51 Lead wire sheared
Car B	3352	1067	98	0	2484	0.67
Miner Truck Spring Snubber (Class C-2)						
Car A	657	144	10	0	456	0.22
Car B	3296	443	40	0	2422	0.58
National Car Stabilizer (Type F-2-A)						
Car A	776	6	0	0	507	0.40
Car B	3398	657	76	1	2543	0.60

* Speed intentionally restricted account of springs going solid.

submitted by the Pennsylvania. The weight of the cars on the rail was approximately 105,000 lb. under the half or light-load condition and 168,000 lb. under the full-load condition. The method of conducting the tests was the same as used with the 40-ton capacity tests. Computation of the lading-damage factors has been made in the same way as for the 40-ton capacity truck tests, but no attempt should be made to compare the figures in Table II with the figures in Table I, since the loads were not the same in both cases. A comparative summary of the lading-damage factors for the 1933 A.R.A. standard coil springs, Class D, and the Kiesel and Young 50-ton capacity trucks is given in Table II.

Results of Riding-Qualities Tests—Eccentric vs. True Wheels —40-Ton Trucks.—A series of tests with 1933 and old standard coil springs was made with four pairs of eccentric wheels, mounted on axles with 5-in. by 9-in. journals, installed under car *A*. True or concentric wheels were used in all runs under car *B*. The eccentric wheels were inspected and measured at the shop, and it was decided that they were not condemnable and the low spots were not worn through the chill. However, it would be an improbable service condition to have all the wheels under a single car so much out-of-round.

In the tests with the eccentric wheels it was found that severe spring oscillation occurred at speeds between 25 and 30 m.p.h., whereas, with round or true wheels, there was no disturbance at these speeds. At high speed the eccentric wheels produced less disturbance than the true wheels. No testing of stabilizing devices with eccentric wheels was done. These tests were of a preliminary nature and no conclusions should be drawn therefrom.

Conclusions.—The tests made in this investigation show that freight cars equipped with 1933 standard A.R.A. or old standard A.R.A. coil springs developed vertical oscillation at critical speeds which is more pronounced at half load than at full load. This vertical oscillation or bouncing can be reduced or practically eliminated by the use of various stabilizing devices in conventional trucks or by special trucks. The effectiveness of the various devices tested was found to vary between somewhat wide limits. The use of these devices should effect savings by the reduction of vertical oscillation in cars which operate at speeds above 36 m.p.h. when cars are equipped with true wheels and at lower speeds when cars are equipped with wheels which are not true.

Service tests on all of these stabilizing devices and special trucks are now being made. Until these tests are completed, it is impossible to reach conclusions as to the comparative durability of these various devices.

All of the comparative tests of stabilizing devices and A.R.A. coil springs were made with true wheels in order to eliminate the variable influence of wheel eccentricity. There appears to be no reason to doubt, however, that the stabilizing devices tested would have similar protective values when used with eccentric wheels that they had with true wheels.

Fig. 124—Summarized Data Average Results For One Round Trip—Rochester To Avon Special Types Of Trucks

Test Trucks Under Car A in all Cases.
Car B Equipped with 1933 Standard A.R.A. Coil Springs in all Cases.

CARS LOADED TO 85,000 LB. ON RAIL

Device	Individual Vertical Shocks 0.25 g	0.35 g	0.50 g	0.75 g	1.25 g	Total Bolster Motion Downward in.	Maximum Spring Deflection in.
Barber Stabilized Truck							
Car A	684	72	16	1	..	436	0.26
Car B	3063	..	1455	642	22	2392	0.45
Coil-Elliptic Springs for Double Truss Truck							
Car A	478	68	4	0	..	1414	0.55
Car B	2217	..	2100	631	20	2417	0.45
Goodwin Car Stabilizer Truck							
Car A			Not Tested				
Car B			Not Tested				
National (Type B) "Coileaf" Truck							
Car A	1107	238	79	1	..	1665	0.39
Car B	5419	..	1821	682	23	2506	0.46

CARS LOADED TO 135,000 LB. ON RAIL

Barber Stabilized Truck							
Car A	888	..	39	14	0	603	0.37
Car B	3602	..	621	77	0	2842	0.62
Coil-Elliptic Springs for Double Truss Truck							
Car A	263	..	5	0	0	1653	0.59 Lead wire sheared
Car B	3450	..	719	85	0	3097	0.59
Goodwin Car Stabilizer Truck							
Car A	614	..	38	11	0	407	0.42
Car B	3646	..	766	85	0	2538	0.57
National (Type B) "Coileaf" Truck							
Car A	424	..	12	1	0	1243	0.41
Car B	3434	..	636	58	0	2958	0.57

Report on Electric Rolling Stock

Moving electric locomotives inside shop buildings, steam heating boilers and front windows for electric locomotives are the subjects reported on this year by the American Railway Association committee on electric rolling stock. The report consists of three exhibits prepared respectively by three subcommittees, and a fourth exhibit which consists of a tabulation of data on electric locomotives placed in service on the Pennsylvania during the years 1930 to 1933, inclusive.

"Methods of moving electric locomotives in roundhouses and terminals" is the subject of exhibit No. 1, prepared by a subcommittee of which the late H. A. Currie, electrical engineer, New York Central, was chairman. This exhibit describes the variety of practices used by various railroads. In some cases the locomotives are moved in and out of shops by steam locomotives or by a second electric locomotive or multiple unit car receiving its power outside the shop while in others, low voltage current is used in the shop for this purpose. In other cases full voltage power is supplied to the locomotive by hand operation of a special cable, and in some instances, a shop crane is used to move the motive power. One railroad temporarily energizes an overhead trolley inside the shop when a locomotive is to be moved, but in all other cases trolley wire is kept outside the shop. Several variations of the practices described are used, and because of the large number of variations the committee makes no recommendations and presents its exhibit as information.

"Automatic control of steam heating boilers on electric locomotives for train heating" is the title of exhibit No. 2, presented by a subcommittee, of which J. V. B. Duer, electrical engineer, the Pennsylvania, is chairman. This exhibit outlines the general requirements of such boilers and describes the methods used by the Great Northern, New York Central and the Pennsylvania. Reference is made to a report on heating apparatus for electric locomotives, presented by an electric rolling stock subcommittee in 1930, in which attention is called to the tendency towards the use of oil-fired boilers installed on the locomotives, or in some cases, on heating trailers. The 1934 report states that since the 1930 report was presented, the use of oil-fired boilers has been extended and progress made in automatic control of boilers and auxiliary apparatus. The report also states that the experience of various railroads indicates several outstanding advantages of automatic boiler control.

Exhibit No. 3, presented by a subcommittee, headed by A. L. Ralston, assistant general mechanical superintendent, New York, New Haven & Hartford, bears the title "Consideration of Design and Operation of Front Windows Arranged for Clear Vision or Window Wipers and Non-Shatterable Glass." The committee finds that for electric locomotives the most general practice at the present time is to use hand-operated window wipers for engineer's and fireman's front windows, which, according to all reports, are found quite satisfactory under varying climatic conditions. Experience with shatter-proof glass was not at first found satisfactory, due to disintegration of binder used between the glass laminations. This condition, the report states, has been materially improved by a change both in the type of binder and glass used, and further states, that the installation of non-shatterable glass is now generally favored. Present practice of 11 railroads in obtaining the required clear vision for enginemen are described.

The report is signed by R. G. Henley (chairman), superintendent motive power, N. & W.; J. H. Davis, chief engineer electrical traction, B. & O.; J. V. B. Duer, electrical engineer, Pennsylvania System; J. W. Sasser, superintendent motive power, Virginian; R. Beeuwkes, electrical engineer, C. M. St. P. & P.; H. A. Currie, electrical engineer, N. Y. C., and A. L. Ralston, assistant general mechanical superintendent, N. Y. N. H. & H.

Action—The report was accepted.

Locomotive and Car Lighting Report

No meetings were held during the year. However, a few matters have been discussed by correspondence, and as a result the committee wish to submit the following recommendations:

Specifications for Axle Light Belting

It is recommended that these specifications be dropped, as more satisfactory belting can be obtained by purchasing to manufacturers' brands, and these specifications are seldom, if ever, used in purchasing axle light belt.

Axle Pulley Bushings and Pulley Locations

The generally accepted practice when using this type of drive is that indicated by the following table, as quoted from the Manual of the Association of Railway Electrical Engineers:

A.R.A. axle journal	Bushing designation	Bushing inside diameters		Location from center line of axle		
		Large end	Small end	To center line of bushing		To center line of pulley
					Max.	Min.
4¼ by 8	B-1	$4^{15}/_{16}$	$4^{15}/_{16}$	0	3¼	0
	B-2	$5^{9}/_{32}$	$4^{27}/_{32}$	10½	13¾	7¼
5 by 9	C-1	$5^{15}/_{32}$	$5^{15}/_{32}$	0	3¼	0
	C-2	6	5½	10½	13¾	7¼
5½ by 10	D-1	$6^{1}/_{32}$	$6^{1}/_{32}$	0	3¼	0
	D-2	$6^{17}/_{32}$	$5^{25}/_{32}$	10½	13¾	7¼
6 by 11	E-1	$6^{19}/_{32}$	$6^{19}/_{32}$	0	3¼	0
	E-2	$7^{1}/_{32}$	$6^{25}/_{32}$	10½	13¾	7¼

Outside diameter of all sizes—7½.
Overall length for all sizes—13.
Note 1: All dimensions given are in inches.
Note 2: Range of pulley locations is based on use of pulleys of standard hub length of 6½ in. and bushings without clamps.

Your Committee would recommend that this table be added to Part H of the Manual, Section III—Pulleys and Pulley Bushings.

The report was signed by W. E. Dunham (chairman), superintendent car department, C. & N. W.; E. P. Chase, foreman, Penna.; H. A. Currie, electrical engineer, N. Y. C.; E. Wanamaker, electrical engineer, C. R. I. & P.; A. E. Voigt, car lighting engineer, A. T. & S. F.; F. O. Marshall, electrical engineer, Pullman Co., and P. J. Callahan, supervisor car and locomotive electric lighting, B. & M.

Action.—The report was accepted.

Arbitration Committee Report

During the year Cases 1721 to 1736, inclusive, have been decided and copies forwarded to the members.

Recommendation is submitted that the effective date of the requirement in Rule 3 pertaining to non-acceptance in interchange of Class F cars, be not extended beyond January 1, 1935; and that similar requirement for Class E-4 cars be not extended beyond January 1, 1936. These requirements first appeared in the Code issued effective January 1, 1929, with effective dates set at January 1, 1931, and January 1, 1934, respectively. Four years extension has been approved in the case of the Class F car and two years in the case of the Class E-4 car, and it is felt, in the interest of safe transportation, no further extension should be granted; but that roads owning this class of equipment, if desiring to continue same in service, should restrict their movement to their own rails. The Committee suggests these propositions be submitted to letter ballot.

In accordance with letter ballot vote last year adopting the No. 15 brake beam as Standard Practice, it was understood no date would be set making the use of this beam mandatory for new cars until such specified date was approved by the General Committee. With the approval of the General Committee, your Committee now recommends a requirement in Rule 3 to provide that the Standard No. 15 or A.R.A. No. 3 brake beam be required on all cars built new on or after January 1, 1935, and suggests this proposition be submitted to letter ballot.

Changes are recommended in Rules 9, 70 and 98 to penalize the substitution of double plate cast-iron wheels in place of single plate cast-iron wheels. This subject has been before the Arbitration and Wheel Committees for the past two years, due to the unsatisfactory performance of the double plate cast-iron wheel which design was eliminated from the Standards by letter ballot action in 1928 by a vote of 2,267 versus 289. Both committees feel it is unfair to the car owner who applies the improved design and specification single plate cast-iron wheel under his cars, to permit foreign roads to substitute the former double plate design in repairs without penalty. It should be understood this recommendation does not prevent any road from using the double plate wheel under its own cars, or applying same in kind under foreign cars without penalty. The repairing line is only penalized when it substitutes the old double plate design for the present single plate design in repairs to foreign cars. The committee suggests this proposition be submitted to letter ballot.

The committee does not feel the other modifications included in its report necessitate submission to letter ballot, the majority of them being routine and covering changes recommended by the Committee on Car Construction, Committee on Wheels, Committee on Couplers and Draft Gears and the Committee on Brakes and Brake Equipment, extensions of effective dates and changes necessitated by letter ballot action last year.

The attention of the committee has been directed to considerable difficulty experienced in identifying trucks with their car bodies, in accidents, due to trucks not having car numbers and initials stenciled thereon. The attention of all car owners is directed to the necessity for such stenciling to facilitate identification, as recommended in Section "L" of the A.R.A. Manual of Standard and Recommended Practice.

All recommendations for changes in the Rules of Interchange submitted by members, railroad clubs, private car owners, etc., have been considered by the committee and, where approved, changes have been recommended.

Attention is again directed to the fact that the Arbitration Committee will not consider questions under the Rules of Interchange unless submitted in the form of Arbitration Cases as per Rule 123.

Freight Car Rules

Rule 2

The committee recommends that third paragraph of Section (b) of this rule be modified, effective August 1, 1934, as follows:

Proposed Form—A leaky tank car shall have stenciled on both sides, in letters three inches in size, adjacent to the car number, the words "Leaky tank. Do not load until repaired," and at the location of the leak the symbol "X," and the owner shall be immediately notified *that the car is being held empty for a period not to exceed fifteen days from date of notification for his disposition*, such notification to indicate definitely location of leak *and point at which empty car is held.* Stenciling must not be removed until the tank is repaired. No charge shall be made for this stenciling.

Reason: To give car owner the opportunity to furnish disposition for such cars, in order to avoid excess empty mileage and with due consideration to prompt return of car to service. This recommendation has been approved by the Transportation Division.

Rule 3

The committee recommends that the effective dates for various requirements in this rule as listed below, now set at January 1, 1935, be extended to January 1, 1936:

Section (a), Paragraph (6)—Axles under 70,000 lb. capacity cars.
Section (b), Paragraph (7)—Brake beam hangers.
Section (b), Paragraph (9)—Bottom rod and brake beam safety supports.
Section (d), Paragraph (3)—Draft key retainer.
Section (f), Paragraph (1)—Stake pockets on flat cars.
Section (f), Paragraph (2)—Stake pockets on flat cars.
Section (h), Paragraph (2)—Hand brake connection.
Section (r), Paragraph (3)—Hatch covers secured by hinges.
Section (t), Paragraph (7)—Head block anchorage on tank cars.
Section (t), Paragraph (8)—Wood shims between longitudinal anchorage and underframe, on tank cars.
Section (t), Paragraph (13)—Dome covers secured by hinge or chain, on tank cars.

Reason: The present situation justifies these extensions.

The committee recommends that no further extension beyond January 1, 1935, be granted for effective date of requirement of Paragraph (u-2) of this rule, providing for non-acceptance in interchange of cars of all-wood construction (Class F); and that the effective date of similar requirement of Paragraph (u-3)

of this rule, covering cars of all-wood underframe equipped with metal draft arms extending 24 inches or more beyond center line of body bolster (Class E-4), be extended to January 1, 1936, with proviso that no further extension beyond that date be granted.

Reason: In the interest of safe operation.

The committee recommends that first paragraph of this rule be modified in the next supplement, as follows:

Proposed Form—Rule 3. No car of an untried type, whether built new, altered or changed, shall be offered or accepted in interchange, nor accepted from car owner, until its size, capacity and design shall have been approved by the Transportation and Mechanical Divisions of the American Railway Association.

In addition to the foregoing, all cars must conform to the following requirements *to render them acceptable* in interchange, or from car owner, as specified:

Reason: To comply with regulations concerning the construction of new equipment as adopted by the Board of Directors of the American Railway Association and issued in Circular No. 2993 dated December 8, 1933.

The committee recommends that Paragraph (1) of Section (b) of this rule be modified, new second paragraph added, present second paragraph to be relocated as new third paragraph, and present third and fourth paragraphs eliminated, as follows:

Proposed Form—(b) (1) Brake beams, A.R.A. *Standard No. 15 or A.R.A. No. 3, required* on all cars built new on or after January 1, *1935.* In interchange.

Reason: To conform with provisions of letter ballot action.

(2) *Brake beams, A.R.A., of not less than the capacity of the No. 2 beam, required on all cars. In interchange.*

Reason: Safety of operation requires that all cars in interchange service should be equipped with brake beams of at least the dimensions of the No. 2.

(3) (Present Paragraph 2 relocated here as new Paragraph 3.)

Reason: Present paragraph eliminated, account covered in new Paragraphs (1) and (2).

(4) (Vacant.)

Reason: Eliminated, account covered in new Paragraphs (1) and (2).

The committee recommends that Paragraph (5) of Section (c) of this rule be modified as follows:

Proposed Form—(c) (5) Couplers having riveted yokes without lugs, where such yokes are riveted directly to the coupler, prohibited. In interchange.

Reason: Excess wording unnecessary.

The committee recommends that a new fourth paragraph be added to Section (r) of this rule and included in the next supplement, to read as follows:

Proposed Form—(r) (4) *Refrigerator cars, ventilated type, built new or rebuilt on or after January 1, 1935, must have the hatch plugs secured by hinges. From owners.*

Reason: As recommended by the Committee on Car Construction.

The committee recommends the addition of a new note following Paragraph (1) of Section (u) of this rule, which paragraph specifies center sills with a minimum cross sectional area of 24 square inches between the draft back stops, to be included in the next supplement, to read as follows:

Note.—This requirement does not apply to the A.R.A. steel sheathed wood lined box car adopted as Standard in 1932, having center sills of "Z" bar section design.

Reason: Any restriction against this type of construction, because of its having less than 24 square inches cross sectional area, should be removed.

Rule 4

The committee recommends that Section (f) of this rule be modified as follows:

Proposed Form—(f) All cars.—*Any or all of the following parts, namely, metal posts, metal stakes, metal braces, metal top chord angles, or their substitutes, metal sheets, metal slats:*

(1) *Cut through the thickness of the metal, except as permitted by A.R.A. Loading Rules. (Flanges only, cut through, will not be cardable.)*

(2) *Bent inwardly 1½ in. or more, or if bulb portion only of pressed steel parts is bent inwardly 1½ in. or more. (Flanges only, when bent, will not be cardable except where necessary to repair under conditions referred to in paragraph 3.)*

(3) *Bent inwardly less than 1½ in., but necessary to repair for proper operation of door or gate, or to comply with Safety Appliance requirements, or to restore alinement of bolt holes, rivet holes, or joints for welding, or to repair cardable directly associated damaged parts.*

Reason: To clarify the intent.

The Committee recommends a new Section (1) be added to this rule, and a new form of card, as follows:

(1) Cars offered in interchange with damage to the extent of Rule 44, must have defect card attached covering such defects, or in lieu thereof, there being no evidence of car having been damaged under provisions of Rule 32, must have information card (as per form shown on page ——) attached covering such defects. Such information card will not be authority for bill nor acknowledgment of unfair usage. Its purpose is to relieve the intermediate line from responsibility for the defects named thereon, and will be considered as notice to car owner that the railroad issuing same will investigate and advise of circumstances classing the defects as owner's responsibility or issue defect card. If an intermediate road finds it necessary to repair such damage, the information card must be attached to bill against car owner. If expense of repairs involves Rule 120, the information card must be attached to statement rendered to car owner in the request under such rule for disposition of car.

THE _____ RAILWAY COMPANY

INFORMATION CARD

Initials _____ Number _____

when delivered by _____ RR to _____ RR

at station _____ Date _____

was damaged to the extent shown in Rule 44, as follows:

_____

_____

Upon completion of investigation, car owner will be advised of circumstances classing these defects as owners responsibility, or defect card will be issued to car owner. This information card is not authority for bill nor acknowledgment of unfair usage.

Signed _____

Date _____ For the _____ RR

Reason: To properly protect intermediate line and facilitate the movement of cars in interchange.

Rule 5

The committee recommends that the extended time limits of second paragraph of this rule, as shown in the 1934 Code, be continued until January 1, 1936.

Reason: Account curtailment in car repairs resulting in holding of bad order cars under present conditions.

Rule 9

The committee recommends that first requirement opposite item of "Wheels and Axles, R.&R." under this rule be modified as follows:

Proposed Form—Cast-steel; wrought-steel; 1-W wrought-steel; steel-tired; *or cast-iron wheels (whether single plate or double plate, which must be indicated by letters "S.P." or "D.P." in service metal column).*

Reason: Account changes in Rules 70 and 98.

The committee recommends that a new seventh item be added to this rule in the next supplement, to read as follows:

Proposed Form—Brake shoe keys, applied—("1934 A.R.A. Standard" must be shown to justify charge).

Reason: To encourage the use of the new Standard brake shoe key, as recommended by the Committee on Brakes and Brake Equipment.

The Committee recommends that a new second requirement opposite item of "Air hose applied," be added to this rule in the next supplement, as follows:

Proposed Form—Air hose applied (New or secondhand. *Cause of removal. Item number as outlined in Rule 56 may be used to indicate cause of removal.*)

The committee recommends that second requirement opposite item of "General" under this rule be modified in the next supplement, as follows:

Proposed Form—Applied sizes of lumber.

Reason: To conform with revised Rule 102.

The committee recommends that fourth paragraph of this rule be eliminated, as follows:

Proposed Form—(Vacant.)

Reason: Unnecessary. Present allowance under Rule 107 includes testing and adjusting.

Rule 12

The committee recommends the addition of a new note under this rule, to read as follows:

Note.—Under this rule any repair shop or repair track of lessor or lessee shall be considered as home.

Reason: To definitely indicate the intent insofar as leased or assigned cars are concerned.

RULE 13

The committee recommends that this rule be modified, and form of joint evidence card modified and printed on one side, only. (Note—See form at bottom of this page.—ED.)

Proposed Form—Rule 13. The joint evidence card *and* copy of billing repair card, covering wrong repairs, when wrong repairs have been corrected, shall be sent to the company issuing such billing repair card. If within sixty days from the date of such request the latter does not issue its A.R.A. defect card covering, bill made on copy of joint evidence and copy of billing repair card shall be final authority, provided the wrong repairs mentioned on joint evidence card are covered by such billing repair card. It must be stated on joint evidence card where and when the wrong repairs were corrected.

Reason: As a measure of economy.

RULE 17

The committee recommends that, effective August 1, 1934, Paragraphs (1) and (2) of Section (e) of this rule be modified as new Paragraphs (1) to (7) inclusive, present Paragraph (3) relocated as new Paragraph (8), and Interpretation No. 19 eliminated, as follows:

Proposed Form—(e) *(1) Except where car is stenciled for higher capacity brake beams, the following substitutions may be made in repairs:*

(2) A.R.A. No. 2, A.R.A. No. 2-plus or A.R.A Standard No. 15 for non-A.R.A., A.R.A. No. 1 or A.R.A. No. 2.

(3) A.R.A. Standard No. 15 for A.R.A. No. 2-plus.

(4) A.R.A. Standard No. 15 must be replaced in kind, except as outlined in Paragraph (5).

(5) A.R.A. No. 3 must be replaced in kind, except where car is stenciled for lower capacity beam, in which event the charge for A.R.A. No. 3 applied shall not exceed cost of beam standard to car.

(6) Except as outlined in Paragraph (5), charges and credits must be on basis of beams applied and removed.

(7) In case of handling line responsibility, charges on above basis may be made against car owner for difference in value between new or secondhand beam applied and secondhand value of beam removed.

(8) (Present Paragraph (3) relocated here—no change in wording involved.) (Eliminated)

Reason: In order to provide for use of A.R.A. Standard No. 15 brake beam in repairs.

The committee recommends that a new Section (i) be added to this rule in the next supplement, as follows:

Proposed Form—(i) *A.R.A. approved friction draft gears, as listed in table under Rule 101, may be substituted for each other or for non-approved types, providing they are interchangeable as to sill spacing and coupler pocket limits. Any increased cost resulting from the application of such approved type friction draft gear shall be charged to car owner, regardless of responsibility for the repairs.*

In the application of non-approved in place of approved type friction draft gear, account owners defects, the gear applied shall be charged at scrap value, credit allowed for approved type gear removed as per Rule 101, and defect card applied to car for labor only of correcting. In case of handling line responsibility, defect card shall be issued for both labor and material.

Reason: Such substitution should be permitted. As recommended by the Committee on Couplers and Draft Gears.

RULE 18

The Committee recommends that last sentence of first paragraph of this rule, and Paragraphs (a) and (b) following, be modified in the next supplement as follows:

Proposed Form—Coupler bodies, types D and E, with cracks in knuckle side *wall* back of knuckle tail, shall not be removed from foreign cars, unless—

(a) Such crack *extends beyond* an area three inches above and three inches below the horizontal center line of knuckle side wall *and 6½ in. back of front edge of knuckle side wall (see shaded area in Fig. C)*, or

(b) Section is broken out within this prescribed area whose greatest dimension exceeds three inches.

(No change in note.)

Reason: As recommended by the Committee on Couplers and Draft Gears.

RULE 19

The committee recommends that third item listed under this rule, covering material that must not be used in making repairs to foreign cars, be modified in the next supplement as follows:

Proposed Form—Cast-iron or malleable iron journal wedges, *or other than solid back A.R.A. design.*

Reason: The application of wedges having corrugated or cored backs, raised letters, etc., should be prohibited.

RULE 23

The committee recommends the addition of a new item to Section III of this rule which is headed "Building up worn surfaces will be permissible on the following," to read as follows:

Proposed Form—Brake hanger bracket pin hole. (Precede this by a dagger.)

Reason: As recommended by the Committee on Car Construction.

The committee recommends that second, third and fourth items of Section IV of this rule which is headed "Welding cracks or fractures will be permitted on the following," be modified as follows:

Proposed Form—*Cast-steel truck sides, *bolsters and transoms.*

Pressed and structural steel truck sides, bolsters and transoms. (Vacant)

Reason: The pressed and structural steel items are built up with rivets and, when annealed, the rivets become loose and the parts distorted. This recommendation has been approved by the Committee on Car Construction.

The committee recommends that Items 1 and 5 under heading "Spring planks, one-piece, may be welded when cracked or broken, as follows" under Section IV of this rule, be modified as follows:

Proposed Form—1. Cracked or broken crosswise, any location; providing crack or fracture does not extend within two inches of longitudinal center line *of spring plank.*

5. Checks or cracks extending outwardly from any hole, *except as provided in Item 1.*

Reason: To clarify the intent.

The committee recommends the addition of a new last sentence to Paragraph (e) of Section V of this rule headed "Regulations for Welding," to read as follows:

Proposed Form—It will not be necessary to anneal brake hanger brackets having pin hole brought back to original diameter by welding where same are cast integral with truck sides or bolsters, unless the truck sides or bolsters are removed from trucks account other welding being necessary.

Reason: As recommended by the Committee on Car Construction.

RULE 26

The committee recommends that Section (c) of this rule be modified in the next supplement, as follows:

Proposed Form—(c) Arch bars and tie bars, as to above stand-

THE _____ RAILWAY COMPANY

REPORT OF IMPROPER REPAIRS—STATION _____ 19 ___

Car No. _____ Initial _____ Received from _____ Ry. at _____ Date _____ 19 ___

Description of Wrong Repairs	How Repairs Should Have Been Made

We Certify Above To Be Correct { _____ Inspector for _____ Ry. / _____ Inspector for _____ Ry.

Date and Place of First Receipt of Car Home Subsequent to Date Wrong Repairs Were Made _____ 19 ___

Date Wrong Repairs Were Made _____ 19 ___ Wrong Repairs Corrected At _____ On _____ 19___

ard dimensions *according to capacity of truck, may be substituted for each other. Charge for bar applied must not exceed that of bar removed.*

Reason: To facilitate repairs and reduce stock of arch bar material.

RULE 32

The committee recommends that a new fifth paragraph be added to this rule to read as follows:

Proposed Form—Side doors, missing from refrigerator cars.

Reason: It is felt such doors would not become missing under fair usage.

RULE 35

The committee recommends that this rule be modified in the next supplement, as follows:

Proposed Form—Empty open-top cars offered in interchange *must* have hopper doors and drop doors safely secured in closed position so that the maximum opening will not exceed three inches. *If cars are offered in interchange in violation of this requirement, such doors shall be made to comply with the requirement at point of interchange by the receiving line, and defect card issued by the delivering line to cover the expense.*

(No change in note following.)

Reason: To make mandatory the closing of doors to safe position prior to interchange, as a safety measure.

RULES 56, 57 & 58

The committee recommends that a new rule be added to the Code, effective August 1, 1934, bracketed "Owners Responsible," to read as follows:

Proposed Form—Rule 56. Except where damaged under any of the provisions of Rule 32, owner will be responsible for renewal of air brake hose when due to any of the following causes:

1. *Burst.*
2. *Leakage discernible without soap suds test.*
3. *Abrasion which has worn through outer covering and shows indication of damage to, or deterioration of, first layer of duck.*
4. *Cracks, longitudinal or spiral, which show indication of damage to, or deterioration of, first layer of duck.*
5. *Soft spots which clearly indicate that the fabric is broken down.*
6. *Loose fittings, either or both ends of hose.*
7. *End of tube 3/8 in. or more from shoulder on either nipple or coupling.*
8. *Porous, as determined by soap suds test. (Billing repair card must specify that soap suds test was made.)*

Note.—Defects as indicated above may be shown on repair records by item number. The letters "SST" may be used following Item 8 to indicate that soap suds test was made.

This will eliminate Interpretation No. 3 of Rule 57, account covered in Item 6 of new Rule 56.

Interpretation No. 2 of Rule 58 will be relocated as new Interpretation No. 1 under new Rule 56.

Several photographs illustrating the defects listed in Items 3, 4 and 5 of new Rule 56 will be reproduced in the Interchange Code in connection with the new rule, as information for inspectors and repairmen.

Reason: To indicate definitely the defects that warrant renewal of air brake hose, as recommended by the Committee on Brakes and Brake Equipment.

RULE 60

The committee recommends the addition of a new sentence to Section (c) of this rule, as follows:

Proposed Form—Where the brass plug with slotted opening is found in the exhaust port of spring type retaining valve, it must be maintained.

Reason: As recommended by the Committee on Brakes and Brake Equipment.

RULE 61

The committee recommends that this rule be modified in the next supplement, as follows:

Proposed Form—In connection with periodical repairs to air brakes, or when car is on repair track for other work, the brake levers shall be checked to assure their conformity with standard dimensions shown on metal badge plate attached to car. Wrong brake levers or wrong brake rods shall be replaced with standard to car at owner's expense, except where brake levers on car are of same ratio as dimensions on badge plate. *Brake beams*, brake hangers, hanger pins and brackets shall also be checked in accordance with the condemning limits shown in Rule 63 and renewed or repaired if necessary. Charge shall be confined to repairs or renewals of these details, no charge permissible for inspection.

Reason: As an additional safety measure.

RULE 63

The committee recommends that first and second paragraphs of this rule be modified and new note added, to be included in the next supplement, as follows:

Proposed Form—Rule 63. (1)—Brake Beam hangers of round or other section, *irrespective of original diameter or thickness*, if vertical thickness of *top* portion of hanger is *worn or* reduced to 5/8 in. or less.

(2) Brake beam hanger of round or other section, *irrespective of original diameter or thickness*, if vertical thickness of *bottom* portion of hanger is *worn or* reduced to 3/4 in. or less when measured vertically or through the corners measured on the radius.

Note.—Brake beam hangers or brake beam hanger pins of diameter or sectional area equal to A.R.A. Recommended Practice should, wherever practicable, be applied when such parts having a less area are removed in defective condition. Such substitution shall not be classified as wrong repairs.

Reason: As a safety measure, due to the large number of failures of brake beam hangers, especially through the bottom section. This recommendation is concurred in by the Committee on Car Construction.

The committee recommends that Paragraph (6) of this rule be modified as follows:

Proposed Form—(6) Brake beam hanger bracket cast integral with truck side or bolster, having pin hole worn oblong to a depth of one-half its original diameter, *or worn oblong so that the remaining material is not less than 60 per cent of the original section,* shall be restored to original diameter by bushing or by autogenous welding process. If the hanger bracket is not cast integral with truck side or bolster, it shall be repaired or renewed when pin hole is worn to the extent specified above.

Reason: As recommended by the Committee on Car Construction.

RULE 66

The committee recommends the addition of the following sentence to Section (g) of this rule:

Proposed Form—When all boxes are repacked in accordance with requirements of this rule due to change of wheels, regardless of responsibility, and repacking date is between six months and twelve months old, the stenciling as required under Section (c) may be changed, for which one-half hour labor may be charged.

Reason: As recommended by the Committee on Lubrication of Cars and Locomotives.

The committee recommends that Section (h) and Item 3 of Section (j) of this rule be modified as follows:

Proposed Form—(h) No charge shall be made for repacking, etc., unless all boxes are repacked and the work complete, in all details, has been performed; or if oil *and waste* used does not meet the A.R.A specifications in all details.

Proposed Form—(j) Journal bearings shall be considered as requiring renewal:

3. When lining is loose or *Section broken out.*

Reason: As recommended by the Committee on Lubrication of Cars and Locomotives.

RULE 70

The committee recommends that Section (c) of this rule be modified, as follows:

Proposed Form—(c) A.R.A. *double plate shall not be substituted for A.R.A. single plate* cast-iron wheels. *(This does not apply in case of one single plate and one double plate wheel mounted on same axle.) Defect card is not required for such improper substitution of wheels. (See Rule 98, Section (c-6), for charges and credits.)*

Reason: To prohibit the substitution of double plate cast-iron wheels to foreign cars, in place of single plate cast-iron wheels which are of improved design and specification.

RULE 78

The committee recommends that second paragraph of this rule and Figure 5 on page 119 be modified as follows:

Proposed Form—Rim, broken—cast-iron and cast-steel wheels: (a) if the width of tread, measured from flange at a point 5/8 in. above tread, is *3½ in. or less* (see Fig. 5); or, (b) If width of tread, measured from flange at a point 5/8 in. above tread, is less than 3¾ in. and the fracture through rim inclines inwardly toward plate (see Fig. 5-A). Measurements to be made with gage shown in Fig. 1 and applied as shown in Figs. 5 and 5-A. See paragraph 115 and Figs. 97 to 101 in Wheel and Axle Manual.

(Fig. 5 to be changed from 3¾ in. to 3½ in. No change required in Fig. 5-A.)

Reason: As recommended by the Committee on Wheels.

RULE 82

The committee recommends that the notes under Figure 7 on page 122 of the current Code, be modified as follows:

Proposed Form—For one-wear wrought-steel and cast-steel wheels.

For *all* cast-iron wheels.

In connection with this change, the wording of first paragraph of Rule 82 will be modified by eliminating the words "for respective capacity wheels."

Reason: As recommended by the Committee on Wheels.

RULE 83

The committee recommends that first paragraph of this rule be modified as follows:

Proposed Form—Rule 83. The application of cast-iron wheels (*regardless* of date cast), of nominal weight less than 750 lb., to axles having journals 10 in. long or over, 700 lb., to axles having journals 9 in. long or over *and* 650 lb. to axles having journals 7 in. long or over, is prohibited.

Reason: The light weight 750-lb. wheel cast prior to June 30, 1924, is unsuitable in modern high speed service and should be placed in the same category as other light-weight wheels. This recommendation is concurred in by the Committee on Wheels.

RULE 87

The committee recommends that the extended time limit of first paragraph of this rule, as shown in the 1934 Code, be continued to January 1, 1936.

Reason: Account curtailment in car repairs resulting in holding of bad order cars under present conditions.

The committee recommends that last sentence of fourth paragraph of this rule be modified as follows:

Proposed Form—In the event of improper repairs of owner's defects, where the road making such repairs rendered bill against car owner for same, but failed to defect card the car at the time, it is optional with car owner to require cancellation of such charges, where billing repair card in itself shows wrong repairs made, instead of requiring defect card to cover. In cases subject to Rule 88, such cancellation applies to labor only *where defect card should have been issued for labor only, and to labor and material where defect card should have been issued for labor and material.*

Reason: To clarify the intent.

RULE 94

The committee recommends that the extended time limits of first paragraph of this rule, as shown in the 1934 Code, be continued until January 1, 1936.

Reason: Account curtailment in car repairs resulting in holding of bad order cars under present conditions.

RULE 97

The committee recommends the addition of a new rule, to read as follows:

Proposed Form—Rule 97. *A component unit of a railway system, whether or not it bears the name or designation of the parent system, shall not, under any of these rules, be considered as a separate road, unless such component unit complies with all of the following requirements, (a) to (d), inclusive, viz:*

(a) Maintains separate accounting, which is not absorbed into the accounts of the parent system.

(b) Receives defect cards from, and issues defect cards to, all component units of the parent system and with the parent system, for all delivering line defects.

(c) Requires the home delivery of its equipment to the rails of such component unit, instead of any other rails of the parent system constituting home delivery.

(d) That the component unit renders its own separate report to the Interstate Commerce Commission.

Reason: To eliminate billing controversies and clarify the intent.

RULE 98

The committee recommends that third and fourth paragraphs of Section (c) of this rule be combined as new third paragraph, and modified, as follows:

Proposed Form—(3) On basis of Rule 83, cast-iron wheels, *regardless* of *cast date,* of nominal weight less than 650, 700 *or 750* lb. *cast thereon,* or without nominal weight cast thereon, shall be credited as scrap, regardless of condition, when removed from service, at expense of car owner in all cases, except as provided for in Rule 68, last paragraph of Rule 81, and in cases where one wheel is broken in derailment when *such* broken wheel will be credited as scrap at expense of handling line, and mate wheel, if undamaged, will be credited as scrap at expense of car owner. In such case, the nominal weight as cast on the wheel, or notation "no cast weight" shall be shown on billing repair card to justify scrap credit.

(4) (Vacant.)

Reason: To conform to revised Rule 83.

The committee recommends the addition of a new sixth paragraph to Section (c) of this Rule, as follows:

Proposed Form—*(6) If, on basis of Rule 70 (c), improper substitution of cast-iron wheels is made, either account owner's or delivering company's defects, the wheels applied shall be considered at scrap value and the wheels removed, if in good condition, or if slid flat, or if damaged under Rule 32 conditions, shall be credited to owner on basis of secondhand value. The same credit will be allowed owner if because of cut journal both wheels are condemned account remount gage or remount limits, or if one wheel is thus condemned and mate wheel is in good condition. Under above conditions, if repairs are made by other than car owner on authority of defect card, the repairing line shall on authority of said defect card bill for labor only, including brasses, box bolts and dust guards (if renewed), and allow credit direct to car owner for difference in value of double plate scrap wheels applied and secondhand value of wheels removed.*

Reason: Account modification of Section (c) of Rule 70.

The committee recommends that a new sentence be added to note following Interpretation 2 of this rule in the next supplement, to read as follows:

Proposed Form—Where A.R.A. Standard steel wheel gage indicates less than 7/8 in. service metal from full flange contour requirement, such wheel shall be considered as having full flange contour provided it does not require turning for other reasons.

Reason: To clarify the intent, as recommended by the Committee on Wheels.

The committee recommends the addition of a new second note following Interpretation 4 of this rule, to read as follows:

Proposed Form—Note.—Secondhand double plate cast-iron wheels substituted under any of the above conditions shall be charged at scrap value.

Reason: Account modification of Section (c) of Rule 70.

The committee recommends that the present 60-day guarantee period in Interpretation 10 of this rule, be extended to read 90-days, this modification to appear in the next supplement and be applicable to wheels applied on or after August 1, 1934.

Reason: It is felt 90 days is a reasonable limit for this purpose.

RULE 101

The committee recommends that first paragraph of "note" under heading "Friction Draft Gears" (shown on page 154) be modified, effective August 1, 1934, as follows:

Proposed Form—NOTE.—The prices shown below are to be charged for various friction draft gears applied new complete, when necessary to apply account of any or all parts of old gear being defective. In conformity with Rule 88, one type of gear may be substituted for another if the type substituted conforms to the one removed as to sill spacing and coupler pocket limits, *in which event* defect card *shall* be issued for labor of correcting wrong repairs, *except as otherwise provided in Section (i) of Rule 17.*

Reason: Account modification of Rule 17.

The committee recommends that Table VIII in the Brake Beam Chart appearing in this rule (shown on page 158) be corrected by eliminating dimensions under the No. 2 beam heading.

Reason: To clarify the intent, as recommended by the Committee on Brakes and Brake Equipment.

RULE 108

The committee recommends that, effective August 1, 1934, the following items be added to this rule:

To Section (a)—*Release lever bracket support, straightened on car.*

To Section (b)—*Pin, securing handle to angle cock, renewed separately.*

Reason: It is desirable to include these items.

The committee recommends that second item under Section (b) of this rule, be modified effective August 1, 1934, as follows:

Proposed Form—Brake shoe keys, *except 1934 A.R.A. Standard,* under all conditions.

Reason: Account modification of Rules 9 and 101.

Passenger Car Rules

PASSENGER RULE 2

The committee recommends that the effective dates of both first and second sentences of Section (c) of this rule pertaining to metallic steam heat connectors, now set at October 1, 1934, and January 1, 1935, respectively; and the effective date of Section (d) of this rule pertaining to platform safety chains, now set at January 1, 1935; be extended for one year.

Reason: The present situation justifies these extensions.

PASSENGER RULE 7

The committee recommends that Paragraph (b) of this rule be modified as follows:

Proposed Form—Rule 7. Owner's defects are as follows:
(b) Cracked or broken glass, *except as provided in Rule 8.*
Reason: To eliminate confliction with Rule 8.

The committee recommends that last sentence of Paragraph (1) of Section (h) of this rule, and Items (a) and (b) following, be modified in the next supplement, as follows:

Proposed Form—Coupler bodies, types D and E, with cracks in knuckle side *wall* back of knuckle tail, shall not be removed from foreign cars, unless—
(a) Such crack *extends beyond* an area three inches above and three inches below the horizontal center line of knuckle side wall *and 6½ in. back of front edge of knuckle side wall (see shaded area in Fig. C)*, or
(b) Section is broken out within this prescribed area whose greatest dimension exceeds three inches.
(No change in note.)
Reason: As recommended by the Committee on Couplers and Draft Gears.

The committee recommends that last sentence of Section (j) of this rule be modified, effective August 1, 1934, as follows:

Effective April 1, 1934, L-2 triple valves applied in repairs to foreign cars, must be equipped with Westinghouse graduating spring and cap nut (piece Nos. 92073 and 92074) regardless of types in valve removed; for which additional charge *is permissible for repairs made on or after August 1, 1934, whether performed separately or in connection with cleaning of triple valve.*
Reason: This betterment is a proper charge versus car owner.

The committee recommends that third sentence of Section (1) of this rule, in reference to stenciling for journal box packing, be modified as follows:

Proposed Form—The stenciling, as per Section (c) of Rule 66, to be located on *one side* of each truck *at diagonal corners of car* where space permits (otherwise, to be placed on *side* of car body at platform end sill or step side *on diagonal corners*).
Reason: To conform to Freight Code. It is unnecessary to stencil passenger cars in four places.

Passenger Rule 8

The committee recommends that first paragraph of Section (a) of this rule, and Items 2, 3, 4, 6 and 13 following, be modified as follows:

Proposed Form—Rule 8. Delivering line defects are as follows:
(a) Removing or cutting out parts of car to facilitate loading or unloading, *or for other purpose.*
(2) Cornering; *sideswiping, misplaced switches; wrong or misinterpreted signals; failure to give or to observe signals; letting cars get away on incline; or failure to properly control cars with car retarding device.*
(3) Train collision.
(4) Impact in switching, *exceeding* damage to couplers and attachments, buffers and diaphragm face plates or parts thereof.
(6) *Pushing car over* bumping post or other fixed obstruction, *or striking overhead fixed obstruction.*
(13) Storm where car is damaged *or destroyed; except roofs, running boards, or parts thereof, damaged or missing due to this cause.*
Reason: To conform with Freight Rule 32 and clarify the intent.

The committee recommends that Section (g) of this rule be modified as follows:

Proposed Form—(g) Missing brake cylinders, reservoirs, triple valves, control valves, pressure retaining valves, cut-out cocks, angle cocks, drain cocks, air hose, steam hose, metallic steam heat connectors, end steam valves, signal hose, *each or all complete,* and any portion of steam train line missing with end steam valves.
Reason: To conform with Freight Rule 58 and clarify the intent.

The committee recommends that a new note be added to Section (g) of this rule in the next supplement, to read as follows:

Proposed Form—Note.—Metallic steam heat connector will be considered as missing in interchange when rubber steam heat hose has been substituted on a car stenciled for metallic steam heat connectors, or where opposite end of car is so equipped and car not so stenciled. When bill is rendered on such defect card, car owner must check his files to determine whether credit was allowed for metallic connector removed when the steam heat hose was applied, as per interpretation under Rule 16, in which event car owner shall bill for labor only.
Reason: To afford car owner greater protection for this detail.

Passenger Rule 13

The committee recommends that, effective August 1, 1934, the following items be added to this rule:

To Section (a)—*Release lever bracket support, straightened on car.*
To Section (b)—*Pin, securing handle to angle cock, renewed separately.*
Reason: It is desirable to include these items.

The committee recommends that second item under Section (b) of this rule, be modified effective August 1, 1934, as follows:

Proposed Form—Brake shoe keys, *except 1934 A.R.A. Standard,* under all conditions.
Reason: Account modification of Freight Rules 9 and 101.

Passenger Rule 19

The committee recommends that first sentence of first paragraph of this rule be modified as follows:

Proposed Form—Rule 19. *Except as otherwise provided,* bills for maintenance of passenger *equipment* cars should be handled as provided in Rules 91 to *98,* inclusive, of the Freight Code.
Reason: To clarify the intent.

Passenger Rule 21

The committee recommends the preamble to this rule be modified as follows:

Proposed Form—Rule 21. The following labor charges *(which include items of expense similar to those enumerated in preamble of Freight Rule 107),* are applicable for the items mentioned:
Reason: To definitely indicate the overhead expense included in these items.

Passenger Rule 22

The committee recommends the preamble to this rule be modified to read the same as preamble to Freight Rule 101.
Reason: To indicate definitely the items of expense included in material prices.

Passenger Rule 24

The committee recommends this rule be modified as follows:

Proposed Form—Rule 24. This Code of Rules shall *become* effective January 1, 1934.
Reason: To clarify the intent.

The report was signed by W. H. Flynn (chairman), general superintendent motive and rolling stock, N.Y.C.; C. T. Ripley (vice-chairman), chief mechanical engineer, A.T. & S.F.; T. W. Demarest, general superintendent motive power, Pennsylvania System; J. J. Hennessey, assistant superintendent car department, C. M. St. P. & P.; T. Beaghen, Jr., superintendent car maintenance, Mexican Petroleum Corp.; L. Richardson, mechanical assistant to vice-president and general manager, B. & M.; M. F. Covert, general superintendent equipment, General American Car Co.; and G. E. McCoy, assistant general superintendent car equipment, Can. Nat'l.

Discussion—One of the members of the General Committee moved that the recommendation in the report against the replacement of single-plate with old double-plate cast-iron wheels, in case of wheel changes due to cut journals or other causes, be held in abeyance for another year, owing to the large number of double-plate wheels, with more or less service life remaining in them, made available as a result of extensive car-scrapping programs. After an extensive discussion, in which it was brought out that the double-plate wheels can be used up on home-owned equipment, the recommendation of the committee that the substitution of double-plate cast-iron wheels for single-plate cast-iron wheels on foreign cars be penalized was sustained.
Action—The report was accepted and necessary items referred to letter ballot.

Prices for Labor and Materials

In order that the rules may currently provide an equitable basis for inter-road billing, the committee has continued the work of analyzing material, labor and new equipment costs in A.R.A. Interchange Rules 101, 107, 111 and 112 of the Freight Car Code, and Rules 21 and 22 of the Passenger Car Code, with a view of determining and recommending necessary changes to be made in supplement effective August 1, 1934.

Rule 101—All miscellaneous material prices in Rule 101 were rechecked as of March 1, 1934, quotations from purchasing agents of ten selected railroads, representing 39 per cent of total freight car ownership in the United States and Canada, indicating a

general upward trend in material markets as indicated by detail recommendations for revisions shown under this rule.

Upon recommendation by the Committee on Brakes and Brake Equipment and with approval of the Arbitration Committee, a new Item 107-A is added to provide for the new 1934 A.R.A. standard brake shoe key.

Item 110 is modified and new Item 110-A added, to provide separate allowances for metal and wood cardboards for inflammable placards.

New Items 124 and 125 are added, and present Items 124 and 125 relocated as new Items 124-A and 125-A, to provide prices for complete couplers of certain types. New notes are added to Items 122 and 123, and new Item 128-C added, to permit additional charge for knuckles with 11-in. face applied separately or in connection with certain additional types of complete couplers. Price for miscellaneous coupler parts (Item 135) is reduced to cast-steel price basis, to discourage the use of these former standards.

New Item 213 is added to provide price for the A.R.A. standard No. 15 brake beam.

The list of friction draft gears is entirely revised and set up in three sections, new Section III consisting of obsolete types of gears which are to be charged and credited as scrap when applied to or removed from foreign cars. This obsolete list was developed by canvassing the manufacturers and includes only such gears as they recommended be placed in the obsolete classification account no longer manufactured or sold. This modification has the approval of the Arbitration Committee and the Committee on Couplers and Draft Gears. One new type of draft gear is included in Section II. The note following this table is modified to clarify the intent.

The table of weights of truck spring coils is modified to include weights for the standard truck spring coils adopted in 1932.

The seventh item in table of weights for miscellaneous items has been modified and a new eighth item added, to provide separate average weights for brake hanger J bolts.

A question has been raised as to the second-hand and average credit allowances for brake beams and the committee is now engaged in a field study to determine correct prices for these items. If modification is found necessary, revision will be made in Code effective January 1, 1935.

Rule 107—Item 20 modified to include four brake connection pins. Items 44, 143 and 172 modified to clarify the intent. New note added to Item 93 to provide additional charge for wear iron bolts which do not pass through flooring, when R. & R. in order to renew flooring.

Item 127 modified to conform to original intent and simplify billing for nails applied.

Allowances under Items 139 and 149 modified in accordance with detail studies of the operations involved.

Rule 111—During the year the Committee conducted field time-studies of the average charge for the cleaning, oiling, testing and stenciling of air brakes, resulting in a reduction in price for this operation which, upon approval by the General Committee, was made effective January 1, 1934.

Rule 112—As only a total of 1,685 freight cars for domestic use were ordered in 1933, which is the lowest total on record, and as 743 of these were constructed in owner's shops, the committee felt it would be useless to assemble data which could be considered represenattive and upon which any change in Rule 112 per pound prices would be justified, and recommends that present prices shown in this rule be continued in effect for another year.

Modification of the additional allowance for cars equipped with A.R.A. approved auto loading device, shown under Paragraph 10 (c) of Section B of this rule, to conform to current market quotations, is recommended.

Passenger Rule 21—New sentence is added to second note following Item 20-C of this rule, to provide description for ready identification of the quick-action or emergency portion of the U-12-B brake equipment.

Two new items are added, setting up labor allowances for metallic steam connectors applied on authority of defect cards and for triple valve graduating spring and cap nut.

Passenger Rule 22—Changes in material prices in a number of items under this rule are recommended, based on quotations as of March 1 from the purchasing agents of 10 representative railroads.

New Items 43-A and 43-B are added, to provide material prices for triple valve graduating spring and cap nut.

Items 52 and 53 are modified and note following eliminated, so that passenger wheels, when below the condemning limits for passenger service will be credited as scrap in the service for which they are intended.

It is the intent of the committee to investigate labor and material costs again in October, and if sufficient change develops, necessary revision will be made and inserted in the Rules effective January 1, 1935.

The changes recommended in the existing rules were included in detail as a part of the report.

The report was signed by A. E. Calkins (chairman), superintendent rolling stock, N. Y. C.; H. H. Harvey (vice-chairman), general car foreman, C. B. & Q.; H. E. Myers, master car builder, L. V.; T. J. Boring, general foreman, M. C. B. Clearing House, Pennsylvania System; H. H. Boyd assistant chief motive power and rolling stock, Can. Pac.; A. E Smith, vice-president, Union Tank Car Co.; A. H. Gaebler, superintendent car department, General American Transportation System, Inc.; P. Kass, superintendent car department, C. R. I. & P.; F. J. Dodds, general car inspector, A. T. & S. F., and O. A. Wallace, supervisor car repairs, A. C. L.

Action. The report was accepted.

Loading Rules Committee Report

The Committee on Loading Rules submits the following report covering revision of the Standard Code of Rules governing the Loading of Commodities on Open Top Cars.

FIG. 1

Experimental Load Cards—Add to card the words: "TEST NO. ———. LOAD NO. ———."

Reason—To enable the Committee on Loading Rules to more clearly identify experimental shipments.

RULE 10

Add Section (g) to read as follows: "(g) For pipe use staple, or nail bent over, to prevent top wire or band from working off stakes."

Reason—To prevent reoccurrence of stake ties working off stakes.

RULE 15

Section (c). Change last sentence to read: "Protect bands *at* stake pockets with metal fillers to provide radius of at least ½ in.; also protect points of contact *having* sharp edges."

Reason—To clarify the rule.

RULE 16

Old heading reads: "Single Overhanging Loads—Width, Height and Length." Change heading to read: "*Loads on one car* overhanging *one or both ends*—Width, Height and Length."

Reason—To make it clear that this rule covers load on one car overhanging one or both ends.

Add third paragraph to read as follows: "Apply coupler spacing blocks as provided for in Fig. 3 and 4, when sliding pieces are used on idler car."

Reason—To prevent damage to lading.

RULE 16

Table. Old heading of first column reads: "Length of overhanging load." Change heading to read: "Length of Overhang."

Reason—To make it clear that the reference applies to the overhang only.

Add the words "RULE 16," over the top of the table.

Reason—To make it clear that this table is part of Rule 16.

RULE 17

Old heading reads: "Weight restrictions for single overhanging loads." Change heading to read: "Weight restrictions for *loads on one car* overhanging *one or both ends.*

Reason—To make it clear that this table covers loads on one car overhanging one or both ends.

RULE 19

Machines of Swinging or Pivoted Type—Inspection and Placards.—The attention of the committee has been called to the fact that many loads of swinging or pivoted type machines are being offered and accepted in interchange without complying with the requirements of Loading Rule 19. The Secretary has been instructed to prepare a circular letter to be issued to the voting members, after approval by the General Committee, calling attention to this fact and stressing the importance of complying with this Rule in all cases. The following form of circular letter has been tentatively agreed upon:

"TO THE VOTING MEMBERS:

Owing to a number of serious accidents having occurred account rotating portions of pivoted cranes not being properly secured, the use of the inspection card shown under Loading Rule 19, page 48 of the Loading Rules, issue of January 1, 1934, was adopted several years ago.

The Committee on Loading Rules believes that such machines should not be moved from shippers' plants or interchange points without proper

inspection being made and these placards being attached to the cars on which such cranes are loaded.

A number of cases have been brought to the attention of the committee where the requirements of Loading Rule 19 were not observed. Before taking further action in the matter, the committee would appreciate your answers to the following questions:

1. Is your railroad inspecting the loads and using the placards as required by Loading Rule 19 in case of machines of swinging or pivoted type? If not, will you please state your reasons?
2. Do the instructions of your railroad provide that loading Rule 19 must be strictly complied with? If so, will you please furnish a copy of your instructions?
3. Do your instructions provide that the absence of inspection card from loads of machines of swinging or pivoted type, as provided for in Loading Rule 19, justifies rejection in interchange?
4. Do you approve of rejection in interchange of loads of machines of swinging or pivoted type where the cars do not carry the inspection card as covered by Loading Rule 19? If not, please state your reasons."

Reason—It has been the observation of the Committee that some roads are not using this important card and the committee feels that the use of it should be enforced by all railroads.

RULE 20

Add new rule to read as follows:

Rule 20. Drop Doors-Open Top Cars.—When loading material (metal or stone) which is short enough to drop through drop door openings in gondola cars, and which is not of such character as is intended to be unloaded through the drop door openings, the door openings must be covered with boards not less than 2 in. thick. This will not be required when door openings do not exceed 25 per cent of the floor surface, provided the material is interlaced or secured so as to prevent it from shifting on to drop doors in transit. Drop doors must be properly closed and secured. Loading such material in self-clearing gondola and hopper cars is prohibited, except when otherwise specified."

Reason—To prevent such lading, not covered by specific figures or regulations, from dropping through door openings.

FIG. 3

Change second sentence of the first paragraph to read:

"Insert metal *or* composite blocks (except cast iron) to fully fill space back of coupler horn."

Reason—The word "or" had erroneously been omitted.

FIG. 6

Change heading to read: "Minimum Requirements for Securing Lumber (*Including Ties, Fence Posts, Etc.*)—Flat or Gondola Cars."

Reason—To make it clear that such material less than 12 ft. long must not be loaded on flat cars, except as provided for in the last paragraph of this figure.

FIG. 21

Item (c)—Change to read: "2 strands, 1 wrapping, ⅛ in. dia. wire, twisted taut, or 2 boards 1 in by 4 in. ea. pr. stakes, each *board* secured with 6, 10-D nails. Not required when load is 9 ft. high or less above car floor."

Reason—To provide for the use of 2 instead of 4 strands of wire which was found to be sufficient.

FIG. 31

Change Item B to read as follows:—4 in. by 5 in. hardwood, or green saplings 4 in. dia. at center, *flat cars, 4 in. by 4 in., or green saplings 4 in. dia. at center for gondola cars.*

Reason—The words underlined have been added to show the dimensions of stakes to be used on gondola cars.

Change Item H to read as follows:—8 strands, 4 wrappings, ⅛ in. dia. wire, passed around *items C and* in the notches of item D. Twist taut between items C and D.

Reason—The words underlined have been added to show proper application of wire.

Change Item J to read as follows:—8 strands, 4 wrappings, ⅛ in. dia. wire, twisted taut. Lower wiring may be omitted when load does not exceed 5 ft. above floor, *flat cars, or when loaded in gondola cars.*

Reason—The words underlined have been added to show that item is not required on loads less than 5 ft. above floor, in flat cars, or when loaded in gondola cars.

FIG. 35

Change to read as follows: Item B, under Nos. of Pcs.: "4 pr. per pile *12 ft. to* 30 ft. long *inclusive.*"

Reason—To coincide with last paragraph which provides that material less than 12 ft. long loaded on flat cars must have end and side protection.

Change Item C to read: "4 in. by 5 in., hardwood, *or green saplings 5 in. dia. at center,* length to suit."

Reason—To provide for the use of saplings.

Change Item E, under No. of Pcs. to read: *"3 per pile 12 ft. to 20 ft. long, inclusive; 4 per pile over 20 ft. long."*

Reason—To furnish adequate protection for various lengths of lading.

Change Item F, under No. of Pcs. to read: *"2 ea. Item E."*

Reason—Changed to coincide with the change in Item E.

Change Item G to read: *"2 ea. item E."* 1 in. dia., *with washers."*

Reason—Changed to coincide with the change in Item E.

Change Item H, under No. of Pcs. to read: *"1 ea. item G."*

Reason—Changed to coincide with the change in Item E.

Change 1st paragraph to read: *"For* rail loading, use items B only."

Reason—To show that side stakes only are required for rail loading and that end protection is not required.

Change 2nd paragraph to read: "Items E, F, G and H are not required when Items B, C and D are used *or vice versa."*

Reason—To show that clamps are not required when stakes and end protection are used, and that stakes and end protection are not required when clamps are used.

Change 5th paragraph to read: "Material less than 12 ft. long loaded on flat cars must have end and side protection consisting of boards 2 in. thick *nailed to inside of Items B and C, or use 2 clamps per pile, Items E, F, G and H. Stakes must be spaced not more than 6 ft. apart."*

Reason—To show that side protection for material less than 12 ft. in length loaded on flat cars must be nailed to side stakes, or that clamps must be used instead; also to show proper spacing of stakes.

Add the letter *E* to identify clamping piece across top of load.

Reason—Omitted in error.

FIG. 37

Correct Item L to read: "2 per *pile"* instead of "2 per post."

Reason—To correct an error.

FIG. 40

Add additional sentence to the first paragraph underneath specifications to read:

"When so loaded Items B, C and D are not required."

Reason—To show that end stakes, end blocking and bolts are not required when wooden clamps and attachments as provided for in first paragraph, following Item J, are used.

FIG. 49

Change Item J to read: 1 *or 2—6 in. by 8 in., hardwood, for loads exceeding* 10,000 lb. per bearing-piece *and less than one-half the allowable weight of load. Two, 6 in. by 8 in., hardwood placed over center sills of car, for loads one-half or over the allowable weight. Place 2 in. by 10 in. by 30 in., hard wood pieces between Item J, and car floor, nailed to prevent shifting.*

Reason—To economize after tests having revealed that it was practicable.

FIG. 50

Change Item J, to read: 1 *or 2—6 in. by 8 in.*, hardwood *for loads exceeding* 10,000 lb. per bearing-piece *and less than one-half the allowable weight* of load. Two, 6 in. by 8 in., *hardwood, placed over center sills of car, for loads one-half or over the allowable weight. Place 2 in. by 10 in. by 30 in., hardwood pieces between Item J, and car floor, nailed to prevent shifting.*

Reason—To economize after tests having revealed that it was practicable.

Change Item M, to read: 2 in. by 10 in by *30 in.* hardwood.

Reason—To specify minimum length.

FIG. 51 REVISED

It is recommended that revised Fig. 51 be substituted for present Fig. 51 and that the following changes be approved.

Change heading to read: "Minimum Requirements for Securing Lattice Girders, Plate Girders, Columns, One-Half Roof Trusses, Etc.—Single Car, Overhanging Both Ends of Flat or Gondola Cars."

Reason—The reference to damage to loading on more than one car to be eliminated account such restrictions being unnecessary.

Items T showing cleats or plate underneath floor to be added.

New paragraph, reading as follows, to be added: "Distance from rail to center of load as given is computed for loads having as much, or more, weight below the center line as above."

Reason—To clarify the intent.

FIG. 51-A NEW

It is recommended that new Fig. 51-A be added to the Loading Rules to cover the loading of Lattice Girders, Plate Girders, Columns, One-half Roof Trusses, etc.

Reason—Experimental shipments have proven that this method of loading can consistently be used as an alternate for Figure 51, thereby, creating considerable economy for the shipper.

FIG. 53

Change Item B, to read: "10 in. by 10 in., hardwood for loads, 65,000 lb., or less, and 12 in. by 12 in., for loads over 65,000 lb. per *bearing piece* Items 'B'."

Change 1st Paragraph to read: "Use Item K, or pivoted bolsters, for I beams or similar material, loaded flatwise (weight 40,000 lb. or more per *bearing piece*, Item B) or when flanges are liable to cut into Item B. Not required for structural beams with flanges 1 in. thick or more."

Reason—The words underlined have been added to indicate that weight shown applies to one bearing piece.

FIG. 54

Change Item B, to read: "10 in. by 10 in., hardwood, for loads 65,000 lb. or less, and 12 in. by 12 in., for loads over 65,000 lb. per *bearing piece* Items B."

Change 1st Paragraph to read: "Use Item L, or pivoted bolsters, for I beams or similar material, loaded flatwise (weight 40,000 lb. or more per *bearing piece*, Items B) or when flanges are liable to cut into Item B. Not required for structural beams with flanges 1 in. thick or more.

Reason—The words underlined have been added to indicate that weight shown applies to one bearing piece.

FIG. 55

Change Item B, to read: "10 in. by 10 in., hardwood, for loads 65,000 lb. or less, and 12 in. by 12 in. for loads over 65,000 lb. per *bearing piece* Items B."

Change 1st Paragraph to read: "Use Item L, or pivoted bolsters, for I beams or similar material, loaded flatwise (weight 40,000 lb. or more per *bearing piece*, Items B) or when flanges are liable to cut into Item B. Not required for structural beams with flanges 1 in. thick or more."

Reason—The words underlined have been added to indicate that weight shown applies to one bearing piece.

FIG. 57

Correct Item C, following Item N to read Item O.

Change Item C to read: "2 *or 4*—6 in. by *8* in., hardwood, *for loads exceeding* 10,000 lb. *per bearing piece and less than one-half the allowable weight of load. Two, 6 in. by 8 in., hardwood, placed over center sills of car, for loads exceeding one-half the allowable weight. Place 2 in. by 10 in. by 30 in., hardwood pieces between Items "C" and car floor, nailed to prevent shifting."*

Reason—To economize after tests having revealed that it was practicable.

FIG. 58

Change Item E to read: "4 *or 6*—6 in. by *8* in., hardwood. *Place 1 at center of each of Items B and C for loads exceeding* 10,000 lbs., *per bearing-piece (Item B) and less than one-half the allowable weight of load. Place 2 over center sills at each Item B, and 1 at center of each Item C for loads exceeding one-half the allowable weight. Place 2 in. by 10 in. by 30 in., hardwood pieces between Items E and car floor, nailed to prevent shifting."*

Reason—To economize after tests having revealed that it was practicable.

FIG. 59

Change Item E to read: "4 *or 6*—6 in. by *8* in., hardwood. *Place 1 at center of each of Items B and C for loads exceeding* 10,000 lb. *per bearing piece (Item B) and less than one-half the allowable weight of load. Place 2 over center sills at each Item B and 1 at center of each Item C for loads exceeding one-half the allowable weight. Place 2 in. by 10 in. by 30 in., hardwood pieces between Items E and car floor, nailed to prevent shifting."*

Reason—To economize after tests having revealed that it was practicable.

FIG. 60

Change Item B to read: "10 in. by 10 in., hardwood, for loads 80,000 lb. or less, 12 in. by 12 in., for loads over 80,000 lb. *per bearing-piece*, Items B."

Reason—The words underlined have been added to indicate that weight shown applies to one bearing piece.

FIG. 61

Change Item C to read: *"7 or 9*—6 in. by *8* in., hardwood. *Place 1 at center of each Items B and C for loads exceeding* 10,000 lb. *per bearing piece (Item B) and less than one-half the allowable weight of load. Place 2 over center sills at each Item B and 1 at center of each Item M for loads exceeding one-half the allowable weight. Place 2 in. by 10 in. by 30 in., hardwood pieces between Items E and car floor, nailed to prevent shifting."*

Reason—To economize after tests having revealed that it was practicable.

FIG. 65

Change Item B to read: "2 in. by 3 in., hardwood 18 in. from ends of piles, length equal to width of car, for material 4 ft. long or over. *Not required on solid bottom cars."*

Reason—The words underlined have been added to make it clear that this protection is not required on cars not equipped with drop doors.

Change last paragraph to read: "Material less than 12 ft. long, loaded on flat cars, must have end and side protection, consisting of boards *2 in. thick, nailed to inside of 4 in. by 5 in. stakes, or green saplings 5 in. diameter at center, spaced not more than 6 ft. apart.*

Reason—The words underlined have been added to show the proper method of securing boards to stakes, proper spacing of stakes and to permit the use of saplings.

FIG. 67

Change Item D to read: "3 strands, ⅛ in. dia. wire. Not required on intermediate piles when piles are tied to each other and to end piles.

Reason—To make it clear that this wiring is not required on inside ends of end piles when piles are tied to each other.

FIG. 70

It is recommended that new Fig. 70 be added to the Loading Rules to cover the loading of wire mesh or bar mats on flat cars.

FIG. 71

It is recommended that new Fig. 71 be added to the Loading Rules to cover the securing of bundled sheet steel, oiled or plain, with high tension bands or wire, on gondola cars.

FIG. 80

Old figure shows one sketch only, with pipe loaded directly one above the other. New figure shows 2 sketches (A & B). Sketch A shows method of loading pipe in nested form. Sketch B shows the loading of pipe one directly above the other and stripped with boards between successive layers.

It is recommended that revised Fig. 80 be substituted for present Fig. 80, the following being added:

ITEM	NO. OF PCS.	DESCRIPTION
D	As Required	1 in. by 4 in.
E	2 ea. end Item D when pipe does not fill space between stakes.	1 in. by 4 in. by 4 in., placed against pipe and nailed to Item D.

If loading per sketch B is preferred, place Item D across full width of load between each layer and not more than 6 ft. apart.

Reason—Previous method of loading has not proven satisfactory account listing sidewise.

FIG. 82

Change Item B to read: "4 in. by *4* in., hardwood, equally spaced, extending above load to permit application of Item C as shown."

Reason—Correction.

FIG. 82-A

It is recommended that new Figure 82-A be added to the Loading Rules, to show method of securing wrought iron pipe on gondola cars with 2 pairs of stakes reinforced with high tension bands encircling the entire load.

FIG. 106

Change to read as follows:

Eliminate the wording from heading: "Length 25 ft. or less."

Item D. No. of Pcs.—2 per pile *30 ft. long or less, 4 per pile over 30 ft. long.*

Item E. No. of Pcs.—1 per pile *30 ft. long or less. 2 per pile over 30 ft. long.*

Reason—It was found to be undesirable to restrict the length to 25 ft. and the underlined words have been added to D and E to take care of the increased length of pipe allowed.

FIG. 107

It is recommended that new Fig. 107 be added to the Loading Rules, to show method of securing galvanized corrugated culvert pipe on gondola cars, with high tension bands without side stakes.

FIG. 110

Change Item C to read: "4 in. by *5 in.* by 8 in., secured with 20-D nails."

Reason—The words underlined had been omitted through error.

FIG. 111

Change Item C to read: "4 in. by *5 in.* by 8 in., secured with 20-D nails."

Reason—The words underlined had been omitted through error.

FIG. 115

Change Item C to read: "1 in. thick, width to suit, *nailed to inside of Items B.* Must be close enough together to prevent loss of lading.

Reason—To make clear that boards must be nailed to inside of stakes.

Add 1st paragraph to read: *Such loading in self-clearing hopper cars must be confined to borings, turnings, loose tin and sheet steel cuttings not more than ⅛ in. thick.*

Reason—To definitely indicate the kind and size of material permitted to be loaded in self-clearing hopper cars.

Add 2nd paragraph to read: *Cars with drop doors must have door openings boarded over with material 2 in. thick unless material is loaded so that it has no bearing on doors, or is interlaced in such manner as will not permit it to drop through door openings.*

Reason—To prevent lading from falling through drop door openings.

Add 3rd paragraph to read: *Metal scrap parts must not be used as substitutes for Items B and C.*

Reason—A necessary safety measure by reason of trouble having been experienced account scrap parts being used as substituted for stakes and boards.

FIG. 128

It is recommended that revised Fig. 128 be substituted for present Fig. 128 and that the following changes be approved:

Old Item C reads: "4—8 in. wide by 16 in. long, height ⅐ dia. of tank, maximum 10 in., nailed to floor with 30-D nails."

New Item B (Old C, revised) to read: "4 *per tank*—8 in. wide, 16 in. long, height ⅐ dia. of tank, maximum height 10 in., nailed to floor with *60-D* nails."

Old Item B reads: "8—4 in. by 5 in., wedge shaped, nailed to floor with 30-D nails."

New Item C (Old B, revised) to read: "8 *per tank*—4 in. by 5 in. by *12 in.*, wedge shaped, nailed to floor *and Items B with 40-D nails.*"

Old Item D (End Blocking) Eliminated.

New Item D to read: *1 per tank—⅝ in. dia. rod or flat band, of equal strength, with threaded ends for tanks* 20,000 *lb. or less one ¾ in. dia. rod or flat band, of equal strength with threaded ends for tanks over* 20,000 *lb.*

Rod not required when loaded in gondola cars with sides 30 in. high or over when end gates are closed and fastened. Substitute, if desired, 2 high tension bands 2 in. wide, strength 7,200 lbs. ea. for ⅝ in. or ¾ in. dia. rods, spaced ⅛ length of tank from ends of tank.

Old Item E (End blocking) eliminated.

New Item E to read: *2 per Item D—½ in. by 4 in. by 10 in. plate at stake pockets, or use 2 in. by 4 in. by 18 in. cleat or ⅜ in. by 4 in. by 6 in. plate when rods pass through floor.*

Three paragraphs to be added as follows:

Metal blocking as shown, or of equal height and strength, may be substituted for Items B and C, secured with bolts, lag screws or spikes ¼ in. dia.

Items B and C not required when metal blocks are used.

When loaded end to end place suitable blocking, properly secured, between ends of tanks to prevent damage.

Steel bracing and method of bolting threaded ends to bands as required in Fig. 131 have also been added to this figure.

Reason—Old Fig. 128, permitted the loading of tanks 8 ft. or less in diameter with end blocking, and without rods, etc., to tie them down. This substitute figure provides for tie downs with the elimination of end blocking, except between ends of tank when loaded end to end. This change was made to provide greater safety.

FIG. 129

It is recommended that revised Fig. 129 be substituted for present Fig. 129 and that the following changes be approved.

Item B—"Rods or bands of equal strength, threaded ends. ⅝ in. dia., weight of tank 20,000 lb., or less, ¾ in. dia., weight of tank over 20,000 lb., or over 10 ft. 6 in. dia., regardless of weight. Not required when loaded in gondola cars with sides 30 in. high or over *when end gates are closed and fastened.*

Reason—The underlined words have been added to make it clear that tie downs must be used when end gates are not closed and fastened.

Item D—"4 in. by 4 in., *long enough to fill space between Items C and E,* nailed to floor with *60*-d nails."

Reason—To provide for proper length of filling blocks and for 60-d instead of 30-d nails.

Old Item E, reading as follows, to be eliminated: "4—2 in. by 8 in., or 4 in. by 4 in., nailed to stakes. Not required on gondola cars."

Reason—Unnecessary in connection with revised method of loading.

Old Item F, requiring 8—4 in. by 5 in. stakes, to be new Item E, requiring 4 stakes.

Reason—Unnecessary in connection with revised method of loading.

Old Item G to be new Item F. No change.

Old Item H to be new Item G. No change.

Old Item J to be new Item H, reading as follows: "4—¾ in. dia. *bolts, 8 required when Items G are not used.*"

Reason—To permit the use of additional bolts in lieu of wedge shape blocks, Items G.

Old Item K to be new Item J. No change.

Old Item L to be new Item K. No change.

The letter *K* in old Item *L* to be revised to *J* in new Item K. No change.

Old first paragraph to be changed to read: "When rod or bands of equal strength with threaded ends are used, Items F, G, H and J are not required, except when 2 or more tanks are loaded end to end these items must be used.

Substitute, if desired, 3 high tension bands 2 in. wide, strength 7,200 lbs. each for the two ⅝ in. dia. rods, or 6 high tension bands, strength 7,200 lb. each for the two ¾ in. dia. rods when Items F, G, H and J are not used. When Items F, G, H and J are used, one band 2 in. wide, strength 7,200 lb. may be substituted for each ⅝ in. dia. rod. Two bands, 2 in. wide, 7,200 lb. each, may be substituted for each ¾ in. dia. rod."

Reason—To provide for the elimination of end blocking when specified bands, etc., are used.

Steel bracing and method of bolting threaded ends to bands as authorized in Fig. 131 have also been added to this figure.

FIG. 131

Change Item D to read: "Washer plates ½ in. by 4 in. by *10* in."

Reason—Necessary in order to provide a stronger washer.

FIG. 132

It is recommended that revised Fig. 132 be substituted for present Fig. 132 and that the following changes be approved.

Change Item B, to read: *"1—Rod ⅝ in. dia., or flat band of equal strength, with threaded ends for sections, 8 ft. or less in dia.;* 2 rods ⅝ in. dia. or flat band of equal strength, with threaded ends *for sections over 8 ft. in dia.* Not required when loaded in gondola cars with sides 30 in. high or over *when end gates are closed and fastened."*

Reason—To provide tie downs for tanks 8 ft. or less in diameter, which was not provided for in old rule. This is a safety measure.

Change Item C to read: "*4* per section—6 in. by 6 in. by 16 in., wedge shaped, nailed to floor with *60*-D nails."

Reason—Experiments have proven that 4 wedge shaped blocks instead of 8 per section are sufficient.

FIG. 153

It is recommended that revised Fig. 153 be substituted for present Fig. 153 and that the following changes be approved:

Change Item B, to read: *"4* in. by 6 in., length of crawler, nailed *or bolted* to floor."

Change Item C, to read: "6 in. by 6 in., *hardwood,* length to suit."

Change Item D, to read: "6 in. by 8 in., *hardwood,* to fit between crawler and Item C.

Change Item F, to read: "*2* in. by 4 in. by *18* in., or metal plates ⅜ in. by *4* in. by *6* in."

Change Item H, to read: "*4* in. by 6 in., long enough to extend beyond Item J, nailed *or bolted* to floor."

Change Item J, to read: "6 in. by 6 in. *hardwood, fit between Item* H *and body of machine."*

Change Item L, to read: "6 in. by 6 in., *hardwood,* length to suit, *wired in position after weight of boom has been placed on same."*

Old Item O, omitted account being unnecessary.

New Item O, reads: *"2—4 in. by 4 in., long enough to fit between Items B, each secured to floor with bolts or 60-D nails.*

Old Item Q, (Tool Box) omitted account being unnecessary.

New Item Q, was old Item R. No change.

New Item R, was old Item T. No change.

Old Item S, (2 bolt cable clamps) omitted account being included in Item Q.

Reason—Experience has proved that the changes were necessary for better loading.

FIG. 154

It is recommended that revised Fig. 154 be substituted for present Fig. 154 and that the following changes be approved:

Change Item B, to read: *"4—4 in.* by 6 in. by *4 ft. each secured to floor with bolts or 4—60-D nails."*

Item C (New Item) reads: *"2—4 in. by 4 in., long enough to fit between Items B, each secured to floor with bolts or 4—60-D nails."*

Change Item D, to read: *"4 in.* by 6 in., long enough to extend beyond Items *F* and *J, each* secured to floor with 4 bolts ⅝ in. dia."

Change Item E, to read: "Bolts ⅝ in. dia., with nuts and washers, through Items D, *S* and floor."

New Item F was old Item C. No change.

Old Item J, reads: "2 in. by 6 in., length to suit, nailed to Item C."

New Item G, (Old J revised) reads: "2 in. by 6 in., length to suit, *each secured* to Item F *with 6—20-D nails."*

Item H (New Item) reads: *"2—1½ in. by 6 in., length to suit, each secured with Items B and F with 6—10-D nails."*

Old Item G, reads: "6 in. by 6 in., length to suit."

New Item J, (Old G revised) reads: *"4 in.* by 6 in., *hardwood, fit tight between Item D and body of machine."*

Old Item H, reads: "2 in. by 6 in., nailed to Items G.

New Item K, (Old H revised) reads: "2 in. by 6 in., *length to suit, each secured to Items J with 6—20-D nails."*

Old Item F, reads: "2 in. by 6 in., length to suit, nailed to floor."

New Item L, (Old F revised) reads: "2 in. by 6 in., *same* length *as Items D, each secured* to floor, *against Items D, with 8—20-D nails."*

Old Item R, reads: "4 in. by 6 in. by 24 in. nailed to floor."

New Item M, (Old R revised) reads: *"6 in. wide, 30 in. long, high enough to keep dipper off floor, hardwood, nailed or bolted to floor."*

Item N (New Item) reads: *"1—6 in. by 6 in., hardwood, length to suit, between boom and dipper stick. Wired in position after weight of boom has been placed on same."*

Old Item O omitted account being unnecessary.

Item P (New Item) reads: *"1—4 in. by 6 in., hardwood, length to suit, wired in position."*

New Item Q was old Item L. No change.

New Item R was old Item S. No change.

Old Item K, reads: "2 in. by 6 in. by 24 in., or metal plates ⅜ in. by 4 in. by 6 in."

New Item S (Old K revised) reads: *"2 in. by 4 in. by 18 in.* cleats, or ⅜ in. by 4 in. by 6 in. plates."

New paragraph added to read: *"When more than ⅙ the width of crawler tread extends beyond the car floor use blocking on top of stake pockets as shown in Fig. 169."*

Reason—Experience has proven that this economy in loading is practicable and safe.

FIG. 158

Old heading reads: "Minimum Requirements For Securing Attachments on Pivoted Machines, Shipped on Their Own Wheels."

Change heading to read: "Minimum Requirements For Securing Pivoted Machines *With Booms Attached Which Do Not Extend More Than 30 Ft. Beyond The End Sill Of The Car On Which The Machine is Mounted."*

Two new paragraphs to be added reading as follows: *"Rotating portion of derrick must be free to swing without any impediment."*

"If the length of boom exceeds 30 ft. beyond the end sill of the car upon which the machine is mounted it must be detached. When detached secure in accordance with Fig. 159."

Reason—To make it clear that boom must be detached when it extends more than 30 ft. beyond the end sill of the car upon which it is mounted.

FIG. 169

It is recommended that revised Fig. 169 be substituted for present Fig. 169 and that the following changes be approved.

Old heading reads: "Minimum Requirements For Securing Tractors, Etc., Weighing 8,000 lb. or Less With Wheels Extending Beyond Sides of Flat Cars.

New heading reads: "Minimum Requirements *For Blocking On Top Of Stake Pockets For Tractors, Cranes, Etc., When More Than ⅙ Of the Width Of Wheel Or Crawler Tread Extends Beyond The End Of CAR FLOOR*—Flat Cars.

Old Item C reads: "10—⅝ in. bolts, length to suit."

New Item C reads: *"3 ea. Item B*—Bolts, ⅝ in. dia., length to suit, *with nuts and washers."*

Old Item D reads: "10—Plate ½ in. by 4 in. by 10 in."

New Item D reads: *"1 ea. Item C*—Plate ½ in. by 4 in. by 10 in.

Old first paragraph reads: "At least ½ of wheel must rest on floor."

New first paragraph reads: *"For Wheels—½ the width of wheel tread must rest on car floor."*

New paragraph added to read: *"For Crawlers—the center line of tread must rest on car floor and not nearer than 3 in. from end of floor boards.*

Reason—To clarify the rule and to provide a better basis for determining when Item B shall be used.

FIG. 180

It is recommended that new Fig. 180 be added to the Loading Rules to cover the loading of auto patrol graders.

FIG. 182

Change Item J, to read: "4 in. by 4 in. length to suit, *nailed to floor."*

Reason—To make nailing to floor mandatory.

FIG. 188

Change Item M to read: "Anti-skid plates for machines *weighing* 6,000 lbs. *or less."*

Reason—It has been found undesirable to limit the use of these plates to machines weighing less than 3,000 lbs.

FIG. 197

Change last paragraph to read: "Single stones loaded on steel floors must be placed on grindings as per Item B, *or* separated with brush, and on wooden floors they must be placed on 1 in. by 2 in. soft wood strips with each stone held in position with 4 hardwood wedges 4 in. by 4 in. by 12 in.

Reason—The word "or" has been added to clarify the intent.

FIG. 207

Change to read as follows:

ITEM	No. OF PCS.	DESCRIPTION
A		Brake Wheel Clearance. See Fig. 2.
B	2	4 in. by 4 in. by 4 ft., *bolted to floor with 2 bolts ⅝ in. dia., each passing through 2 in. by 4 in. by 18 in. cleats, or ⅜ in. by 4 in. by 6 in. plates underneath floor.* Not required when space between lading and ends of gondola cars will not permit.
C	6	4 in. by 5 in. by *10 in.*, nailed to floor with 20-D nails. Not required when Item *D is used or when loaded in gondola cars.*
D	4	4 in. by 4 in., extending 6 in. above car floor. Not required in gondola cars.

See General Rules for further details.

Reason—The underlined wording has been added to strengthen end blocking.

FIG. 211

Change Item B, to read: "4 per pile—2 in. by 3/16 in. *flat band with threaded ends, or ¾ in. dia. rod,* length to suit."

Reason—To provide for the use of ¾ in. dia. rods as substitutes for flat bands.

FIG. 212

It is recommended that new Fig. 212 be added to the Loading Rules to cover the loading of two wheel auto trailers on flat cars.

It is recommended that the foregoing suggestions for revision of and additions to the Loading Rules be submitted to letter ballot of the members, and if approved that they be included in a supplement to the Loading Rules to be effective January 1, 1935.

The report was signed by S. Lynn (chairman), superintendent of rolling stock, P. & L. E.; E. J. Robertson (vice-chairman), superintendent car department, M. St. P. & S.S.M.; R. H. Dyer, general car inspector, N. & W.; G. R. Lovejoy, master mechanic, Detroit Terminal R. R.; T. O. Sechrist, assistant superintendent machinery, L. & N.; C. J. Nelson, superintendent of interchange, Chicago Car Interchange Bureau; J. A. Deppe, assistant superintendent car department, C.M.St.P. & P.; W. B. Moir, chief car inspector, Pennsylvania; and H. S. Keppelman, superintendent car department, Reading.

Action—Report was accepted and referred to letter ballot.

EDITORIALS

Mechanical Division Conventions

No one familiar with present-day transportation problems will question the fact that we are in a period when radical changes must be made if the railroads are to continue to prosper and remain the backbone of American transportation. The Administration, in its Emergency Railroad Transportation Act of 1933, established a Federal Co-ordinator of Transportation, an innovation which, in the direct expense of the Co-ordinator's organization and in the vastly greater indirect expenses involved by the co-operation of the railways with the Co-ordinator, cost the railroads, on a conservative basis, many hundreds of thousands of dollars for the first year of operation—and the expense will be greater for the present fiscal year. Thus far the Co-ordinator's organization has been engaged mostly in studying the transportation problem with a view to making recommendations for revising the Transportation Act, and in investigating and studying railway services and practices, and in accumulating data, on the basis of which further studies can be made, with a view to more orderly and rapid progress.

What part can the various railway associations play in this effort to improve the railway services, and in order that the railways may operate more effectively and with greater economy? On another page will be found an interview with a railway executive on the work of the various associations and the importance of their activities. The Mechanical Division for several years has eliminated the conventions, and in their place has held meetings of the General Committee with such of the committee chairmen as might be needed. Has not the time come for speeding up the activities of the Mechanical Division and of holding meetings of the entire membership?

It must be remembered that only a few roads are represented in the kind of meetings which have been held in the last three or four years. It may be argued that the roads not represented do not suffer, since they have the right to vote on the letter ballots. There is, however, a distinct feeling in some quarters that the questions which are submitted to letter ballot would be drawn up in a somewhat different form, if all of the roads had an opportunity to participate in the discussions and decide on just what questions were to be presented to letter ballot, and how they should be presented.

The fact must not be overlooked, also, that participation in the conventions by a large number of representatives is invaluable from the standpoint of the educational effect. It will be much easier to secure whole-hearted co-operation in the adoption of recommended practices and standards if the mechanical officers generally have a thorough understanding of how these practices and standards were developed, and why they were adopted.

As indicated, also, by the railroad executive who was interviewed, there has been a considerable change in the personnel of the mechanical department in recent years, and the new men who have come into supervisory positions are much in need of the inspiration and help they will get by meeting men in like positions from other railroads, and in discussing common problems with them in committee meetings and conventions. Surely, the time has now come when the former activities of the mechanical department associations should be resumed and speeded up.

Apparently the General Committee of the Mechanical Division, A.R.A., is quite strongly of this opinion, since it decided by unanimous vote at its meeting in Chicago last month, to hold a "full membership" meeting in June, 1935. The question as to whether or not exhibits will be made in connection with the convention will, of course, depend upon business conditions and mutual agreement between the Mechanical Division and the Railway Supply Manufacturers' Association. The point was advanced in the discussion at the General Committee meeting, however, that a sufficiently large number of new appliances, tools, equipment specialties, etc., have been developed since the exhibit at Atlantic City in 1930, to justify the special study and consideration of mechanical department officers. Without doubt the exhibit is an important factor in making the conventions of the mechanical department officers more effective and it will be wise to include it next year if it is at all possible to do so.

The Freight Car Of the Future

In an address before the annual convention of the American Association of Railroad Superintendents at Chicago on June 20, J. R. Turney, director, Section of Transportation Service of Co-ordinator Eastman's organization, reviewed the conditions under which the railroads now operate and those which they must face in the future because of new forms of competition. From the implications of these conditions he derived specifications for the freight car of the future, which he summed up in his conclusions as follows: "In sum, then, the ideal freight car, not of the future, not of tomorrow, but of today, is one light enough to carry five times its weight; strong enough to drag one thousand times its weight; versatile enough to handle any

commodity in any weather or temperature; insulated, coolable and heatable; adaptable in size to present-day sales unit requirements; providing security for person and property; dependably speedy in terminals as well as on the road; accessible for loading and unloading from any one of its six sides, and finally attaining both mobility and utility by being quickly and cheaply transferable from rail to highway chassis vertically, longitudinally and laterally."

These specifications are at variance with certain tendencies in the development of freight cars during past years as well as with some of the ideas which have been put forth by agencies outside of the railroads as means for their future rehabilitation. They are sound from a railway operating standpoint in that they call for versatile units which will not be limited to the handling of one or a few commodities. It is in this respect that they differ from the ideas which call for specialized types of equipment to meet the service requirements of specific classes of service.

They emphasize the protection of lading, which the railroads must prepare to handle with no greater special protection than is required for movement over the highway.

The objective in box-car design for the past twenty years or more has been to produce a car which could stand up under collision shocks of constantly growing severity. The impact tests of the new standard steel-sheathed wood-lined box car indicate considerable improvement in the balance of the design of this car as compared with those of earlier design, but the most significant conclusion from the impact tests is stated in the report as follows: "Experience gained through the action of the heavy corrugated steel housing and timber blocking installed at the door openings of all three designs to protect the impact recorders indicate quite definitely that at switching speeds having upper limits of five to six miles an hour lading ordinarily handled in box cars is subject to severe damage and may not be expected to survive destruction at the higher speeds under which steel-sheathed car structures of reasonably good design begin to fail."

It is evident that the building of car structures of sufficient strength to be proof against damage or destruction under collision shocks of increasing severity has reached a point beyond which it is useless to go. If the railroads are to continue as a factor in the movement of merchandise, they must either develop operating conditions in which the severity of the shocks to which the equipment and lading are subjected is sharply reduced, or they must provide more effective shock protection. Only in this way will it be possible to provide a car "accessible for loading and unloading from any one of its six sides" suitable for handling anything but bulk loading.

Aside from changes in the form of the container portion of the equipment to meet the convenience of the shipper and to facilitate railway-highway interchange, the point of greatest moment to the railways at the present time is shock protection. Better train handling with the AB brake, and better car riding with non-harmonic springs are already available. Protection against end shocks involving sudden changes of velocity of five or more miles an hour within conventional draft-gear travel, while sufficient to prevent destruction of the cars, is not adequate to prevent destruction of lading.

The Mechanical Division Reports Progress

While the meeting of the American Railway Association, Mechanical division, at Chicago, on June 27 and 28 was limited practically to members of the General Committee, committee chairmen and a few other interested mechanical-department officers, the meeting was particularly valuable because of the opportunity it afforded to review progress during the past year and make constructive plans for the future. Even a cursory examination of the reports presented affords conclusive evidence of the great volume of more or less routine committee work handled and also shows how much attention the division has given to important problems involving engineering research, service tests and development work in connection with improved modern materials and methods. A total of 17 working committees reported to the division and, of these, at least six described progress or completed tests involving more or less advanced engineering studies.

An important feature of the General Committee meeting on June 27 and 28 was the repeated reference to research work and tests which proved such a dominant part of the committee activities during the year. One of the outstanding reports in this connection was that of the Committee on Car Construction, which, in addition to reporting progress in testing improved freight-car trucks and spring-snubbing arrangements, also condensation in steel roof box cars, has completed the extensometer, deflectometer and impact tests of the A.R.A. standard double-sheathed box car, with highly satisfactory results. This car, which is generally conceded to be the best balanced design yet developed, represents the combined experience of the Committee on Car Construction and the American Railway Car Institute. By the efficient use and distribution of materials in this car structure, a weight saving of 3,500 lb. is effected without loss of strength; in fact, the standard car showed a marked superiority in the elimination of excessive local stresses and the ability to withstand severe impact tests, made under full axle loading and at speeds up to 18.3 m.p.h., without developing weaknesses in design or indications of distress or distortion.

An examination of the reports indicates that other committees of the Mechanical division have, by persistent effort, perfected locomotive details; continued research in draft gears; specified maintenance requirements for the new AB freight-car brake; developed improved car-wheel specifications; studied the important

problem of lubricating railway equipment; tested and specified more efficient loading methods, and analyzed the requirements for more safe and satisfactory tank-car service. Under the supervision of Director H. A. Johnson, the Research Committee has given attention to a total of 19 additional special assignments, making extensive surveys, studies, or tests in connection with such subjects as standard method of rating and inspecting locomotive coal, streamlining of high-speed passenger trains, air-conditioning of passenger cars, possible savings in operating cost by the use of lighter freight cars, economies of freight-car dimensions and capacities, railway refrigeration service; automatic train-line connectors, etc.

Back Shop or Enginehouse Repairs?

Differences of opinion have always prevailed among mechanical officers as to the type of repair work that should be performed on locomotives at engine terminals. Some are of the opinion that a locomotive which is given a thorough overhauling during the period of general repairs in the back shop should logically require a minimum of repair work at the enginehouse, while others believe that certain repair work, even of a heavy nature, can profitably be performed at enginehouses and thereby prolong the period of service on the road between general shoppings. Unfortunately it is not possible to draw any very accurate conclusions from available data as to which may be the better policy. One thing, however, is certain and that is that the back shop on most roads should be the logical place to make the heaviest locomotive repairs because of the fact that most engine terminals are not equipped with facilities adaptable to much heavier work than that of changing wheels or rods.

There recently came to our attention a study of some repair statistics made by one of the large roads which showed the effect of business depression on locomotive maintenance policies. This road in 1928 spent approximately 65 per cent of the money for labor involved in locomotive repairs in the back shop and 35 per cent in the enginehouse. In 1932, due to the curtailment of heavy repair work and concentration on running repair work, the same road spent only about 35 per cent of the labor bill in the back shop and the remaining 65 per cent in the enginehouse. The astonishing result was that the cost of applying one dollar's worth of material to a locomotive increased 45 per cent from 1928 to 1932.

Two conclusions might be drawn from such a study —either that an investigation should be conducted by that road to determine the adequacy of its enginehouse repair facilities or that, in spite of curtailed operations, it is certainly not profitable to attempt heavy locomotive repairs where proper facilities are not available.

Developing a Better Understanding

At the spring meeting of the American Society of Mechanical Engineers at Denver, Colo., the session sponsored by the Railroad Division was devoted to papers on the design and construction of the two first lightweight, articulated, high-speed passenger trains—the Union Pacific train of aluminum-alloy construction and the Burlington Zephyr of stainless-steel construction. Further evidence of the value of these trains in arousing a lively interest on the part of the public in the railroads was presented by the attendance at this session of mechanical engineers with many connections other than the railways, who showed in the discussion a highly intelligent and sympathetic interest in the problems of design and operation of trains of this character.

In the development of means for friendly contact between the railways and the public this meeting clearly suggests the value of taking various phases of the technique of railway operation before groups of informed laymen for discussion. More frequent discussions of railway problems, both general and technical, before mixed groups of railway and non-railway men will satisfy the latent curiosity of the public concerning railways and their operation and will at the same time provide the railways with intelligent criticism. It is the privilege of all patrons to criticize. It lies largely with the railways whether the criticism shall be uninformed and destructive, or informed and of constructive usefulness.

NEW BOOKS

SPECIAL SLIDE RULES. *Engineering Extension Series Bulletin No. 32. Purdue University, Lafayette, Ind. By J. N. Arnold, instructor in engineering drawing, Department of Practical Mechanics. 42 pages, 6 in. by 9 in.*

This booklet takes up the theory and principles involved in special slide rules, logarithmic relations and a bibliography of previous literature. Directions are given for the construction of slide rules for special purposes and examples of special rules for a selected number of formulas. The information given would be found exceedingly helpful by anyone attempting to construct special slide rules to meet their needs where commercial rules do not fully meet requirements.

PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE. *The Lincoln Electric Company, Cleveland, Ohio. 5¾ in. by 9 in. 450 pages, illustrated. Bound in semi-flexible simulated leather, embossed in gold. Price, $1.50.*

This new volume of the Procedure Handbook is encyclopedic in scope. The eight principal sections deal with various phases of arc welding in a simple, concise manner with detailed drawings and photographs. Among the new features included are: Weld inspection (visual, stethoscopic, electro-magnetic, X-ray and Gamma-ray); study of stress distribution by polarized light; simplified method for design of welding machinery; procedure and speeds for welding aluminum; technique and speeds for welding copper, etc.

With the Car Foremen and Inspectors

Mounting Car Wheels*

DURING the past few years, especially since the publication of the American Railway Association Wheel and Axle Manual, a pronounced effort has been made at many railroad shops to develop a uniformly correct practice in mounting wheels. At the invitation of several roads, this operation has been carefully investigated by local shop forces, in conjunction with the Association of Manufacturers of Chilled Car Wheels, so as to learn and establish the factors that enter into it. Mounting tests, conducted at the Argentine (Kansas City) and Corwith (Chicago) shops of the Santa Fe, also at the Galesburg (Ill.) shop of the Burlington and at several manufacturers' shops, have been supplemented by data from 69 other railroad shops furnished in response to a questionnaire.

The forces involved in pressure fits of car wheels are: (1) ram pressure; (2) radial pressure between the axle wheel seat and the hub of the wheel; (3) circumferential stress in the hub of the wheel. The ram pressure is the product of the coefficient of friction and the radial pressure. The circumferential stress is dependent on the radial pressure.

By the use of a proper lubricant, a coefficient of friction of 12½ per cent can be established between the wheel and axle and the radial pressure inside the hub of the wheel can be figured for any given ram pressure. From this calculated radial pressure, the circumferential stress, and hence the circumferential strain, can be determined. The theoretical tolerance, or the amount by which the diameter of the axle exceeds the diameter of the wheel bore, can then be figured by determining the increase in diameter necessary to produce a unit increase in circumference of the wheel bore equivalent to the calculated circumferential strain.

Following this procedure, the theoretical tolerances between the wheel bore and the wheel seat are as shown in the table. This table indicates that a tolerance of .003 in. would be sufficient to produce a ram pressure of at least 50 tons in all wheels if the surface of axle and wheel bore were polished perfectly smooth and the machine shop work in all respects absolutely accurate. This, however, is not within the practical range of the machine work performed for mounting wheels on axles. It is necessary to allow at least .003 in. for roughness of the tool marks on the machined surfaces and for the inaccuracy of calipering by various individuals at various shops. It may, therefore, be considered that .006 in. is the minimum tolerance that should be used in regular practice for chilled-iron wheels.

Theoretical Tolerances Between the Wheel Bore and the Wheel Seat

Weight of wheel, lb.	Normal ram pressure, tons	Circumferential stress, lb. per sq. in.	Theoretical tolerance, in.
650	50	8,100	.0024
700	55	8,450	.0026
750	60	8,750	.0030
850	65	8,030	.0028

Shop Tests Show Relation Between Theory and Practice

The foregoing represents a very brief outline of the theory of mounting wheels. In order to establish a relationship between theory and practice, a large number of shop tests were made. In these tests, all tolerances were carefully measured with micrometer calipers. Ram pressures were taken with an indicating as well as a recording pressure gage. The circumferential strains were measured at four points on both the front and back hubs with a strain gage. The lubricants used for covering the machined surfaces were varied from machine oil to a mixture of 60 lb. white lead to 1 gal. of boiled linseed oil. The tolerances were varied from .004 to .045 in.

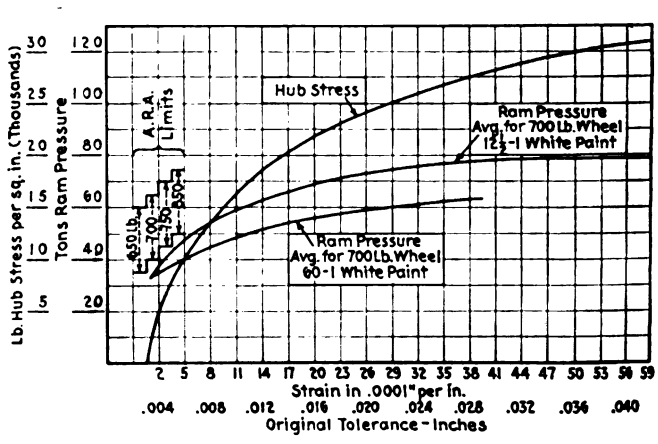


Fig. 1—Relation of tolerance to ram pressure and stresses in the hub

Relation of Tolerance to Ram Pressure and Hub Stress.—One of the first things observed in these tests was that increasing the tolerance does not result in a proportional increase in ram pressure. This is especially true for larger tolerances. An increase from .006 in. to .009 in. results in an average change in ram pressure, in the case of a 700-lb. wheel with A.R.A. lubricant, from 47 tons to 58 tons, while an increase from .020 in. to .030 in. tolerance produces ram pressures from 73 to 78 tons. The average ram pressures required to mount the 700-lb. wheels using the A.R.A. 12½-to-1 white lead mixture with varying tolerances and also a 60-to-1 white lead mixture are shown in Fig. 1. This chart also shows the relation between the tolerance and the stress in the hub of the wheel and illustrates the comparatively rapid increase in stress as compared to the increase in ram pressure. The one outstanding factor is that increasing the tolerance is not a practical remedy for low ram pressures. High tolerances punish the metal, place undue strain in the hub of the wheel and fail in the objective of increased ram pressure. This is more completely illustrated in Figs. 2 and 3, showing the final ram pressures and the manner in which circumferential stress and strain built

*Condensed from a pamphlet "Theory and Practice of Mounting Railroad Wheels on Axles," published by and available upon request of the Association of Manufacturers of Chilled Car Wheels, McCormick building, Chicago, Ill.

up in the front and back hub, with various tolerances, as the axle advances.

These charts are very instructive and strongly bring out the fact that the desirable tolerances are between .006 and .009 in. It will be noted that the ram pressure increases very slowly above .010 in. tolerance while the strain, which is dependent only on the tolerance, increases rapidly.

Relation of Lubricant to Ram Pressure.—The results of tests with various lubricants show that at tolerances as low as .006 in. there is no appreciable variation in ram pressure. Tests at higher tolerances, however, indicate a decided reduction in the coefficient of friction if the amount of white lead in the paint is increased. As a general rule, heavy lubricants result in a reduction in ram pressure of from 25 to 35 per cent, compared to those obtained with the A.R.A. mixture of 12½ lb. of white lead to 1 gal. of boiled linseed oil. The comparative effect of light and heavy lubricants can be illustrated as follows:

It is desired to press a 700-lb. wheel on an axle at 60 tons ram pressure. A reference to Fig. 1 shows that where the A.R.A. standard lubricant is used, a tolerance of .010 in. will be required, producing a stress in the hub of the wheel of 16,000 lb. per sq. in. If the heavy, 60 to 1 lubricant is used, however, the tolerance will have to be increased over 100 per cent, to .021 in., to obtain this tonnage and, in doing this, the hub stress is increased to 24,500 lb. per square in., or approximately 75 per cent of the ultimate strength. No advantage is evident in using these heavy lubricants which would even approximate the disadvantage of the high resultant stresses; in fact, under the necessarily high radial pressures produced by the high tolerances, uniformity of lubrication is impossible and there will be more of a tendency for misfits. This clearly illustrates the advantage of using the correct lubricant. Throughout the tests, of the lubricants used, the A.R.A. standard of 12½ lb. of white lead to 1 gal. of boiled linseed oil, which had been mixed from 12 to 24 hrs. previous to its use, proved to be the best from the wheel-mounting standpoint.

Machining and Fitting Second-Hand Wheels and Axles

With the recommended limit on tolerance for the mounting of wheels at .006 to .009 in., the limits which might be established for out of roundness or taper on second-hand wheels would out of necessity have to be very small. With a limit of .003 in., over half of the second-hand wheels would have to be rebored, and it certainly would not be prudent to establish a larger limit in so much as .003 in. is already 30 per cent of the recommended maximum mounting tolerance. Considering the time consumed in making the necessary measurements to ascertain if it is feasible to avoid reboring, and the desirability of having consistently uniform fits, it appears that all second-hand wheels should be rebored before mounting.

The results of measurements taken of the bore of a

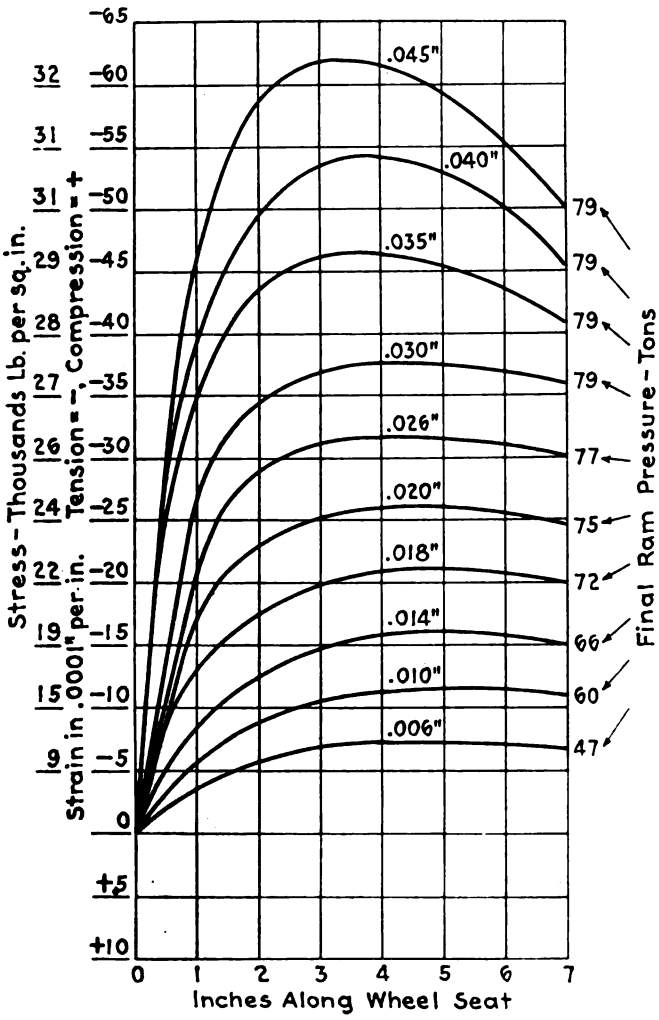


Fig. 2—Chart showing the strain in the back hub of a 700-lb. single-plate wheel mounted with various tolerances on a 6½-in. diameter wheel seat

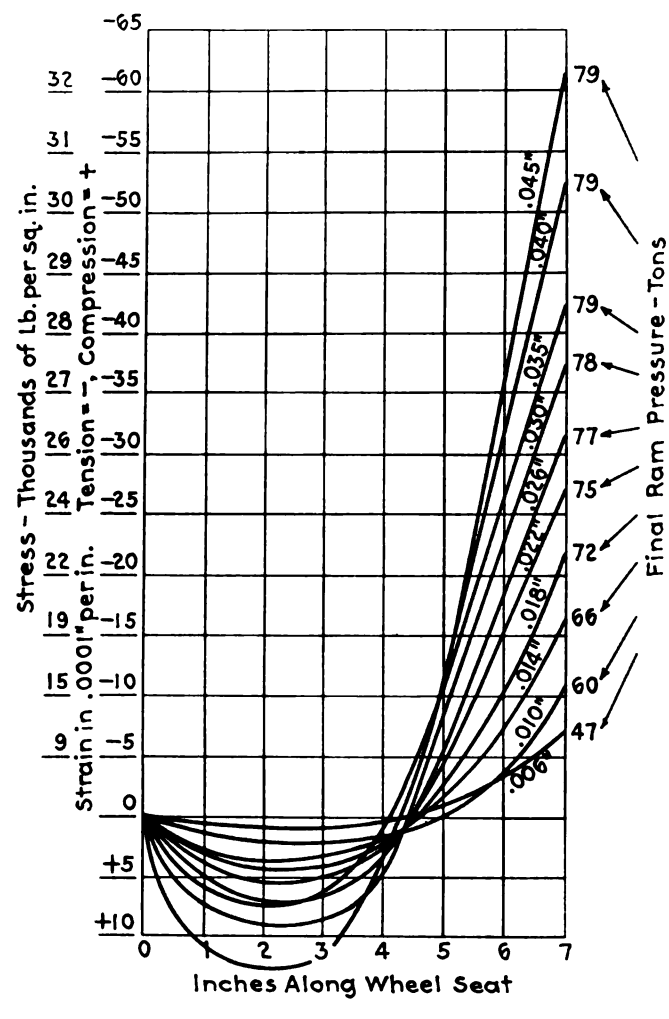


Fig. 3—Chart showing the strain in the front hub of a 700-lb. single-plate wheel mounted with various tolerances on a 6½-in. diameter wheel seat

large number of second-hand wheels chosen at random, to determine their condition, are shown in Fig. 4. Each wheel bore was measured at the front, center and along each of the two principal axis. If the limit of .002 in. is established as a maximum out of roundness or taper in the bore, 77 per cent of the wheels would have to be rebored, and, with .003 in. as the limit, 62 per cent would require reboring.

Some shops are reluctant about reboring all second-hand wheels unless it is absolutely necessary because of

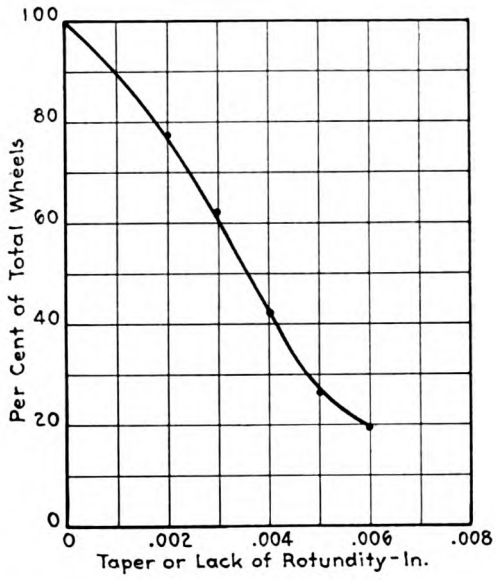


Fig. 4—Condition of the bores of 100 representative second-hand wheels selected at random from a large group of wheels used on many different roads

the anticipated danger of exceeding the maximum allowable diameter, necessitating the scrapping of the wheel. However, upon investigation in a shop where all second-hand wheels are rebored, of some 6,000 second-hand wheels, only four had to be scrapped because of an oversize bore. In the majority of cases in which the wheel would have been scrapped because of a large bore, some other service defect condemned it.

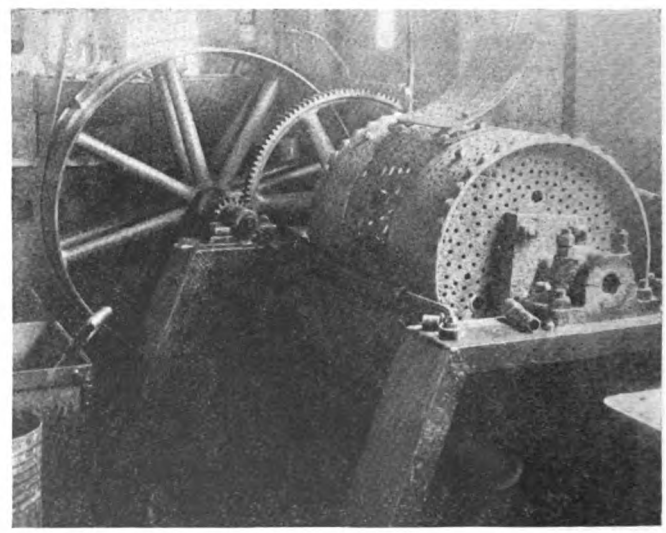
Eccentricity of the Wheel Bore.—It has been observed in some cases that wheels, in which the bore is not concentric with the worn tread, are shimmed up in the mill to center the bore with the boring bar. Considering only the fit between the wheel and the axle, this is satisfactory, but, from the standpoint of final results desired, this practice should be condemned. A wheel bored 1-16 in. off center compares to a track with regular waves ⅛ in. high every 8½ ft. The result is a tendency for the wheel to hop and, due to the action of the springs, it will at times actually leave the rail. The damaging effect to the rail, wheel, lading and, in fact, to the entire car, can readily be imagined. This is very definitely illustrated in the progress report recently issued by the Mechanical division of the American Railway Association on tests made for the promotion of easier riding of cars.

Taper and Out of Roundness of the Wheel Seat.—Similar to the bore of a second-hand wheel but usually to a lesser extent, the axle wheel seat is tapered and lacks true rotundity. A badly tapered wheel seat, with the small end of the taper toward the center of the axle, results in a very rapid rise in ram pressure at the beginning, but, instead of gradually increasing until the wheel is completely pressed on, remains constant or may even fall off. This condition frequently yields a ram pressure under the A.R.A. limits and, in addition, the possibility of the wheel's coming loose in service. A tapered wheel seat in which the small end is nearest the journal is not nearly so serious but, if excessive, makes it impossible to select the proper fitting tolerance so as to obtain the desired mounting pressure. To eliminate judgment in this respect, 23 out of 69 railroad shops make a practice of turning all axle wheel seats. Because of the axle economics involved, it appears desirable to avoid machining the axle wheel seat, if possible. To accomplish this, however, good practice dictates that some limits for taper or lack of rotundity must be established. All wheel seats with a taper whose small diameter is closest to the center of the axle must be turned, taking a cut only deep enough to insure a truly rotund and cylindrical wheel seat. When the wheel seat lacks either rotundity or has a taper in excess of .003 in., a skin cut only deep enough to produce a perfect surface should be taken off of the axle.

Salvaging Pipe Fittings

By A. Skinner

MANY pipe fittings are received at reclamation shops from various points along the railroad where locomotives and cars are being scrapped, a substantial proportion of these fittings being suitable for further service if properly reclaimed. These fittings usually come to the reclamation shop in all kinds of conditions, with union parts separated, some fittings loose, and others connected in scrap pipe. In the latter case, the scrap pipe is unloaded at the shears and the clear sections of pipe cut away to be subsequently scrapped, or worked up into nipples if in sufficiently good condition. The fittings are then taken to the stripping bench where the short pieces of pipe are removed with suitable wrenches, drift pins, or a cape chisel, if necessary.

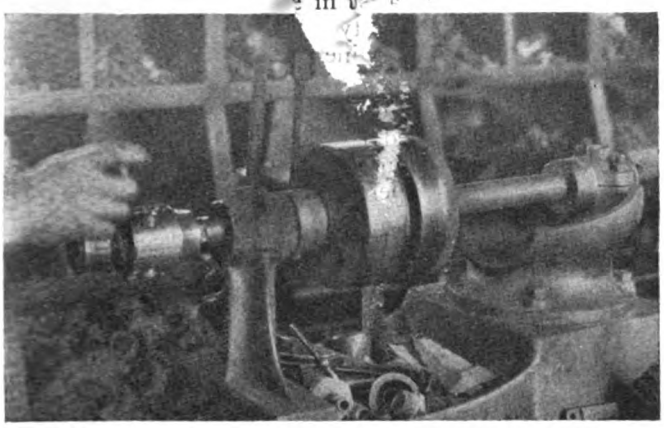


Perforated drum which revolves in a distillate bath and is used for cleaning pipe fittings

The stripped pipe fittings of all kinds are taken to a revolving drum, illustrated, which is used to clean the fittings by immersing them and rolling them about in a bath of distillate oil. This drum is made from an old main air reservoir, 24 in. in diameter by 33 in. long, which revolves on a 2-in. steel shaft carried in cast-

iron box bearings bolted to a 5-in. welded channel-iron framework. The drum is perforated with numerous small holes, through which the oil passes readily, and is provided with a substantial hinged door to facilitate easy insertion and removal of the pipe fittings. A combined gear and belt drive from an overhead line shaft revolves the drum at a speed of approximately 6 r.p.m.

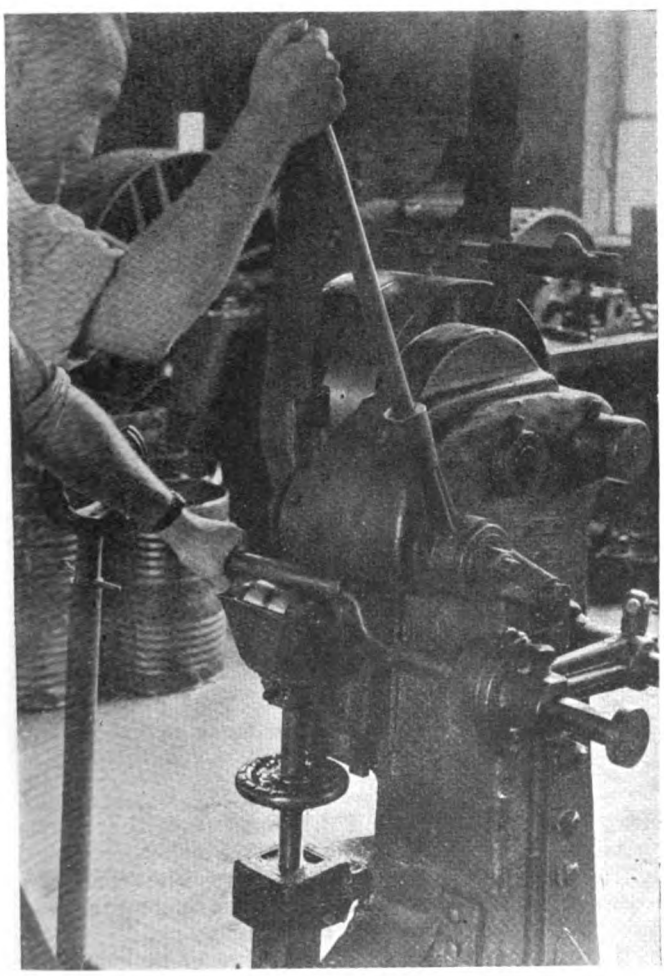
An oil container, also made from one-half of an old air reservoir, is held in position underneath the perforated drum, supported by four S-hooks from two horizontal rods, one on either side of the drum. The bottom of this oil container is located about 8 in. below the bottom of the drum to give adequate oil capacity when the oil level is carried from 4 to 6 in. above that point. Pipe fittings to be cleaned are placed in the drum, the hinged door closed and securely fastened, and the drum revolved for about two hours. The resultant tumbling action of the fittings in a bath of oil has the effect of thoroughly loosening grit, dirt and scale, thus leaving the fittings well cleaned when properly drained. A drain pan 36 in. long by 25 in. wide by 5 in. high is located on the floor underneath the machine to catch oil drippings. As a general rule, it is necessary to change the distillate in the container about once a month.

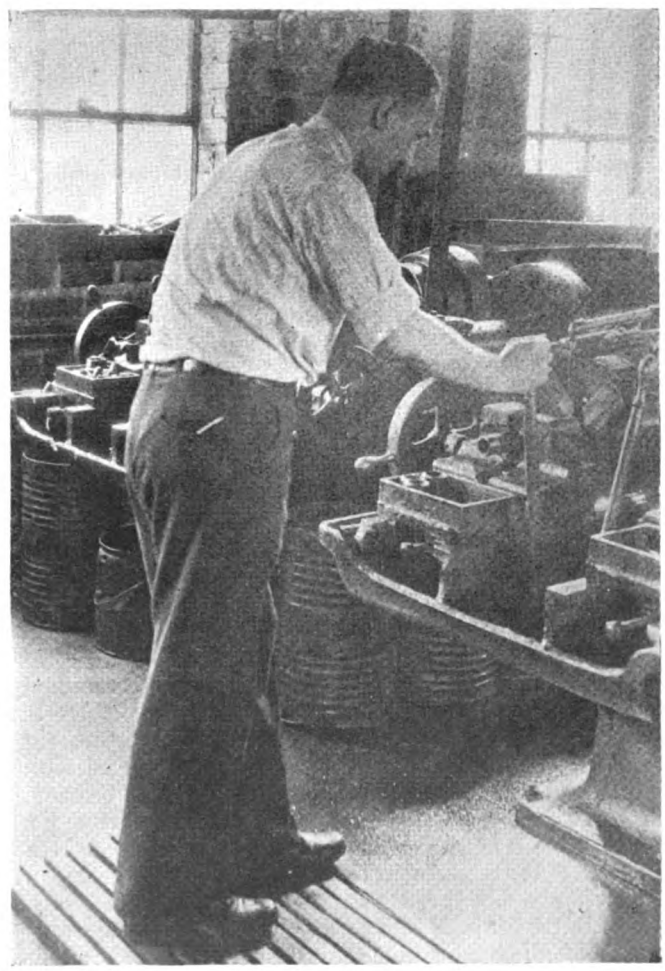


Belt-driven spindle and chuck arrangement used in refacing union swivels

After being cleaned, all fittings are thoroughly inspected and checked, if necessary, to discover any with defective threads, these being scrapped. In the case of unions, the belt-driven spindle and chuck arrangement, shown in one of the illustrations, is used to reface the union swivel. This machine is made from a small stationary engine, stripped of all parts except the base and bearings, which support a shaft equipped with 2-in. by 6-in. tight and loose pulleys, with belt drive from an overhead line shaft. The outer end of this spindle is threaded to receive a drill-press chuck, which holds a nipple and the swivel which is to be reseated. A hand file is used lightly to remove the rust and a fine emery cloth for subsequent polishing, care being exercised to maintain the original ball contour on the union swivel.

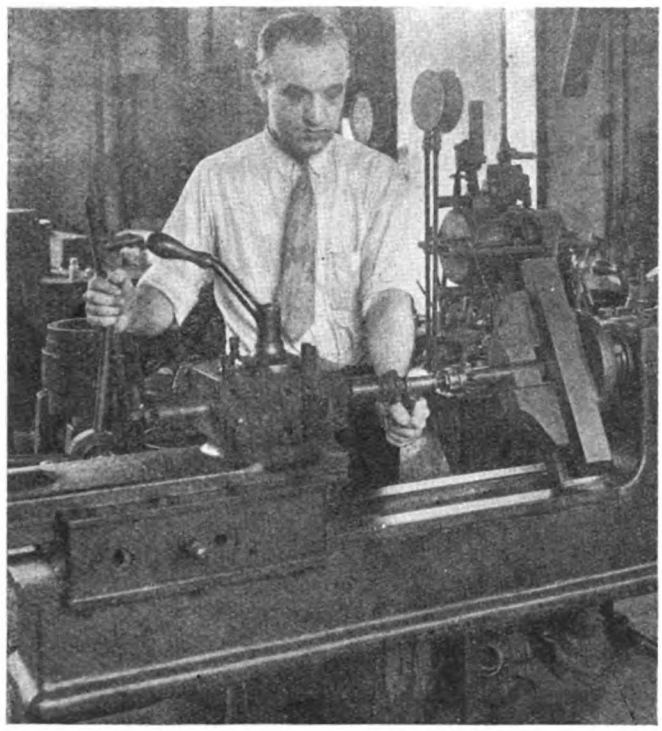
For reseating the taper joint on the other part of the union, the turret lathe, shown in one of the illustrations, is used in conjunction with two reseating





Murchey pipe nipple cutting machine (left) and double-head threading machine (right)

tools similar in type but adapted to the different sizes of unions. The larger of these tools has 27 flutes and is made with a 45-deg. taper. It is 3¾ in. in diameter at the large end and 1¾ in. at the small end. The reseating tool used for smaller fittings has the same taper but is made with only 15 flutes, the large diameter being 1⅝ in. and the small diameter, 1½ in. The union part to be reseated is threaded onto a bushing, close nipple and tee assembly, supported in one tool post of the turret lathe and provided with a short handle pipe to prevent turning when the union seat is forced up against



Turret lathe and special tool used in truing worn union taper seats

the reseating tool which revolves at about 62 r.p.m. Only enough material is removed to true the union seat.

If union nuts are defective, they are scrapped and replaced by new ones. The union parts are then assembled loosely and the swivel revolved against the seat by hand, a visual examination readily indicating whether or not there is a bearing all around. No pressure test is made of the reclaimed unions as this is unnecessary. The production with this method of reclaiming is about 100 unions a day.

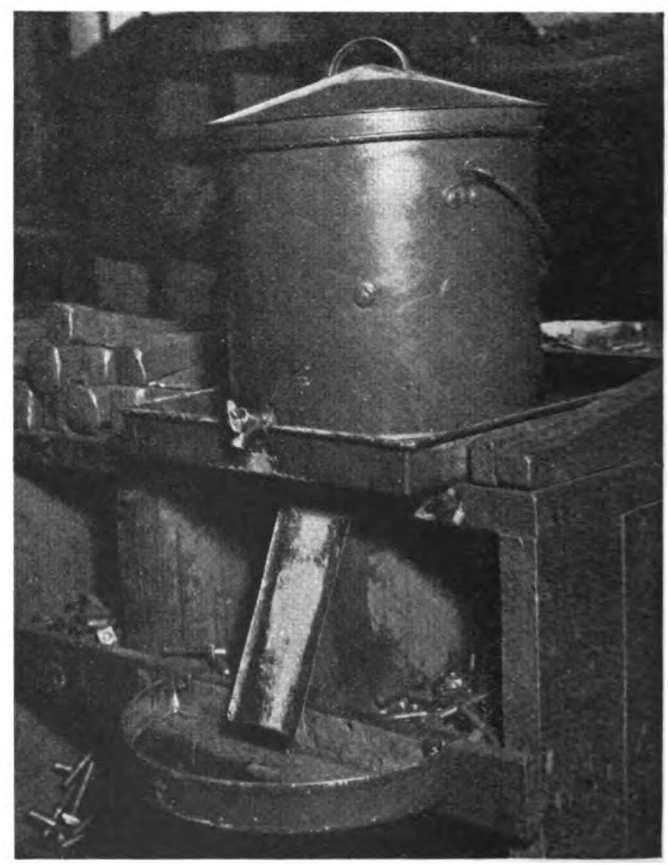
The extra-heavy wrought-iron pipe is inspected and, if not corroded, sent to the pipe shop to be made into nipples. These nipples are inspected and cut into standard lengths from close nipples to 6-in. nipples, and in all sizes from ¼ in. to 2 in. Those nipples which appear to have an accumulation of lime scale on the inside are immersed in cut muriatic acid to loosen and remove the scale. The operation of cutting nipples is shown in one of the illustrations, which indicates, at the left, a Murchey pipe-cutting machine equipped with a 5-in., high-speed, steel cutter and double, ball-bearing, 2-in. rolls which permit the pipe to revolve during the cutting operation. A paraffin cutting oil is used as a lubricant. At the right in the same illustration is shown a Murchey double-head thread-cutting machine, which is used to cut threads on the nipples. The average production of nipples by this method of operation is about 500 per 8-hr. day.

Oil-Storage Can

LARGE amounts of oil are used at railway car shops and proper attention to methods of handling frequently not only effect labor savings and economies in oil consumption but keep storage-room floors and passageways free from oil drippings, thus avoiding slippery conditions and possible resulting accidents.

Oil-storage cans of the type illustrated have demonstrated their value as containers for oil in the car shop, making the oil required for priming passenger-car journals readily available to the car men and yet assuring a clean floor. The can is made of sheet metal, with a close fitting cover to exclude dirt and a faucet about one inch above the bottom to permit readily drawing off the oil as required. A screen filter is inserted in the can about half way between the top and the bottom to prevent particles of waste or other foreign matter from getting down to the faucet.

The oil-storage can is placed on a shallow leak-proof pan located at a convenient point on the storage rack where car men come frequently for other materials required in repairing cars. A small strip of sheet metal is nailed to the storage rack or bench directly under the

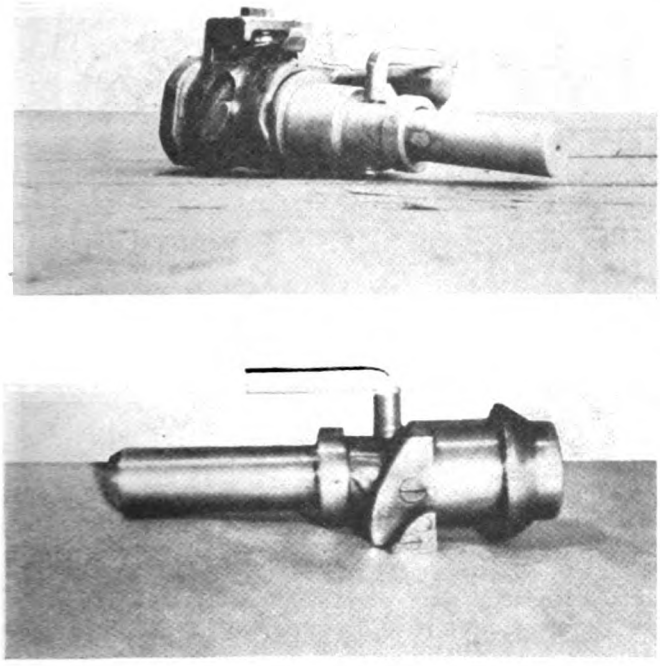


Small oil-storage tank which contributes to safety and avoids fire hazard

faucet, thus leading any oil drippings from the faucet into a small semi-circular pan below, which hooks onto the front of the storage rack and is readily removable for emptying when necessary. This arrangement is a simple but effective method of avoiding an oil-soaked bench or floor with attendant possibility of accident and fire hazard.

Gaging Steam-Hose Coupler Heads

A METHOD of gaging No. 312 steam-hose coupler heads is shown in the illustration. The gage end is machined to fit in the gasket recess and stops are provided which engage in the locking groove. The L-shaped handle revolves and indicates whether or not there is sufficient metal on the lip to secure the proper locking by the other coupler. If there is not sufficient metal, it is added by welding or brazing on enough stock to bring this to the proper height. The upper illustration shows the gage in position in the coupler head and the lower view shows the gage separate. The use of this gage assures proper fitting of the coupler before it is put into service.



Special gage used in checking steam hose coupler heads

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Substitution of Harvey Springs, Followers And Spools in Place of Friction Draft Gears

The Missouri Pacific removed a Bradford rocker-type friction draft gear from a Texas & New Orleans car on account of a broken casing and applied a second-hand Harvey friction draft gear in repairs. In three other cases friction draft gears were removed from T. & N. O. cars for similar causes and Harvey spring gears were applied. Among other gears removed were Miner A-2-S friction draft gear and Westinghouse NY-10 friction draft gear, bills rendered for material charges ranging from $18.40 to $20.41 per gear replaced. M. P. defect cards were attached to each of the cars referred to for labor only at time improper repairs were made. T. & N. O. took exception to M. P. material charges, contending that Harvey friction spring gears applied in repairs were not friction draft gears; therefore, not proper substitutes under Rule 101 for Bradford, Miner and Westinghouse draft gears removed account defects, and requested M. P. to confine material charges for Harvey friction spring gears applied to scrap value on weight basis with proper credit for friction draft gears removed, in line with interpretation 5, Rule 88. This the M. P. refused to do, stating net store department cost of gears to M. P., less credit allowance for defective gears removed in conformity with credits established under Rule 101 had been charged and they considered material charges to be correct. Failing to agree as to charges for material, the matter was referred to the Arbitration Committee for decision. It was the contention of the T. & N. O. that while true that the springs in the Harvey friction spring gears are friction springs, it is also true that the gear as a whole is not a friction draft gear, and that the fact that this gear is not listed under A.R.A. Rule 101 under friction draft gears indicates it is not recognized as such by the A.R.A. In support of claim that material charges for Harvey friction spring gears should be for scrap on a weight basis when applied in replacement of defective draft gears, reference was made to interpretation 5, Rule 88. It was the contention of the M. P. that interpretation 5 of Rule 88 was intended to cover the application of all spring gears and followers and not intended to cover the substitution of one type of gear for another. The Harvey friction gear consists of one back spring pocket, weight 116 lb.; one spring seat, weight 80 lb.; one unit plunger, weight 36 lb.; one front follower, weight 74 lb., each consisting of cast-steel, charged at weight of A.R.A. prices for steel castings under Rule 101. In addition, this gear carries one A.R.A. "D" type draft spring, weight 55 lb., charged at A.R.A. price, and one Harvey triple friction spring charged at store cost. The new price for the gear complete would be approximately $33.61 and second-hand value at 75 per cent of the cost new, $25.21. They also contended that to reduce price of Harvey gear on basis of weight at ½ cent per pound would be approximately $1.80 and would compel them to credit friction draft gear removed at prices under Rule 101 in addition to defect carding for labor only. It was, therefore, contended that they were justified in using the basis of value when substituting the gears and thus avoid sustaining a loss as requested by reducing material charges to a scrap weight basis.

In a decision rendered October 26, 1933, the Arbitration Committee said: "The combination of springs, followers and spools applied by the Missouri Pacific does not constitute a friction draft gear within the intent of Rule 101. Therefore, Rule 88, interpretation 5, governs. The contention of the Texas & New Orleans is sustained."—*Case No. 1729, Texas & New Orleans vs. Missouri Pacific.*

WOODEN PASSENGER EQUIPMENT is no longer to be seen on the Norfolk & Western. The last wooden car owned by the railroad, stripped of fittings and trucks, was recently lifted by two cranes, lowered on to a huge pile of scrap material and set on fire. Within recent months, 175 wooden N. & W. cars have been destroyed at the railway's Roanoke, Va., shops.

In the Back Shop and Enginehouse

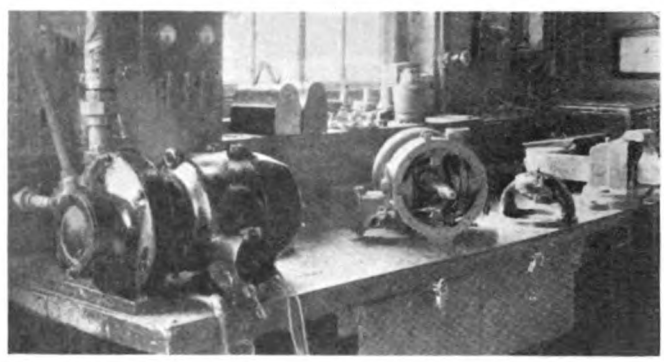
Maintaining Train-Control Equipment

AN effective method of maintaining train-control equipment in good operating condition has been developed on the Chicago & North Western, some of the equipment and tools for handling this work at intermediate terminals, such as Clinton, Iowa, being shown in the illustrations. Train-control apparatus, furnished by the General Railway Signal Company, is installed on the locomotive, consisting of a receiving unit mounted on the pilot, a relay case located between the air compressors on the front end, a governor case on the running board, a driving unit connected to the right front-truck axle, necessary conduits and wire connections, and miscellaneous indicating and control equipment in the cab. The latter includes an actuator mounted on the brake valve, a speed and acknowledging horn, and a visual indicator with two green and yellow lights indicating proceed and caution, respectively. Electric power for lighting, as well as to actuate the train-control system, is provided by a Pyle-National, Type E-3, electric generator.

The relay case, referred to, includes an amplifier, a primary relay, a contact group for the cab signals and a dynamotor. The governor case includes a governor, a centering device and a contact group for speed and distance. The driving unit consists of a gear on the right end of the leading front-truck axle, transmitting power through a small universal expansion drive shaft connection to the governor case.

Train-control equipment is kept in the desired condition as regards maintenance by means of monthly, quarterly and annual tests, and repair work which varies from minor running repairs, indicated as necessary by the periodic tests, to more extensive work when locomotives are received in the shop for heavy repairs. The monthly test referred to consists of a ground test of the entire equipment, testing the Plitron tubes, examining the conduit and electrical connections and tightening any which may be loose. At the quarterly test, all cases and terminal boxes are opened, wires checked for tightness and a thorough examination made, no parts being removed, however, if they test satisfactorily. At the annual test, usually made in conjunction with heavy repairs to the locomotive, all train-control equipment is removed, cleaned and inspected, and broken or worn parts renewed. When heavy repairs are being made, all wires through conduits are renewed, regardless of condition.

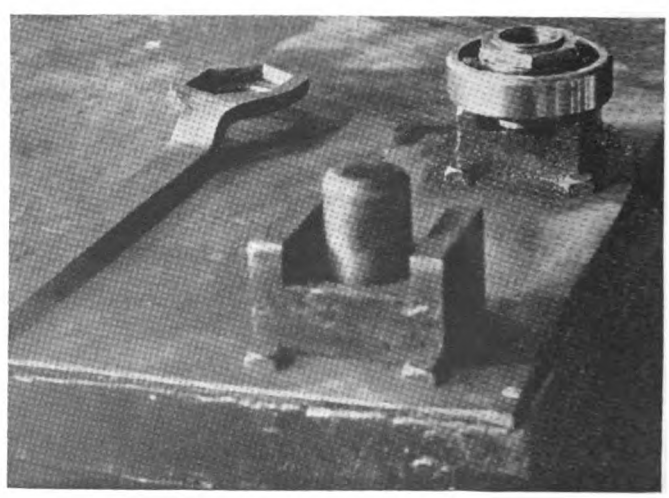
The electric generator is completely dismantled, cleaned, and the inside of the case painted red. Field and armature windings are tested for grounds and carefully inspected for evidences of possible mechanical defects. The commutator is turned in a lathe and the segments undercut. All worn parts are renewed, the ball bearings being adjusted or renewed, if necessary. In this connection, an interesting device, shown in one of the illustrations, is used for dismantling or reassembling the ball-bearing units. A short, round, steel spindle of the same size as the armature shaft is inserted in a steel block, bolted to the work bench and provided with two upward projecting lips which are spaced wide enough apart to grip milled recesses in an extension of the inner raceway and hold it from turning while the nut is being applied or removed by means of a special wrench, illustrated. To attempt to hold this raceway in the jaws of a vise while removing the nut is almost sure to distort



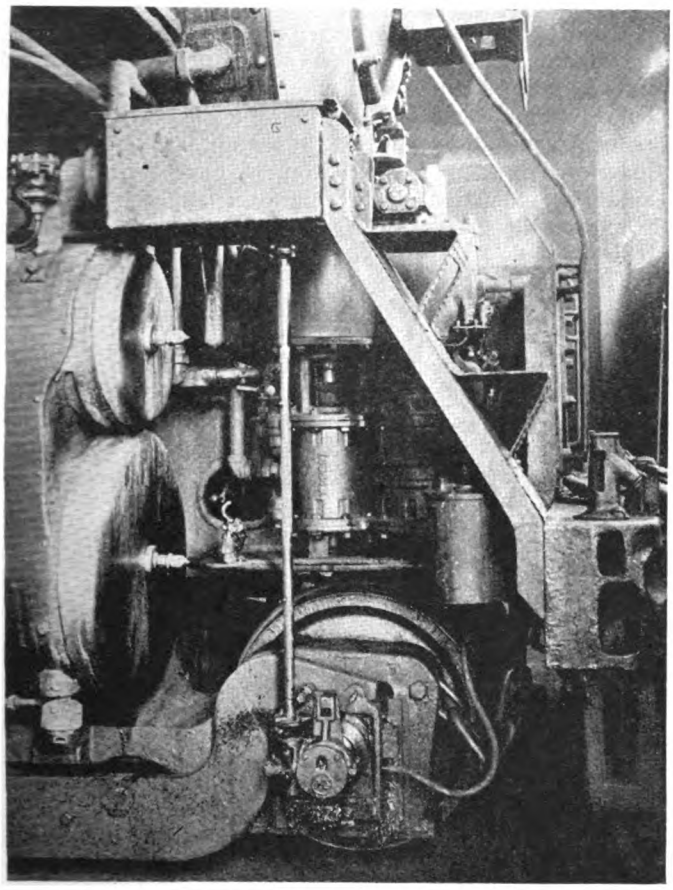
View of the repair shop where electric generators and train-control equipment are overhauled

or damage it in some way. Following the reassembling of the generator, it is operated with steam and under various load conditions for eight hours before being applied to the locomotive. The pipe connections for this testing are shown in the illustration.

The same procedure as in overhauling the generator is used in making general repairs to the dynamotor, except that it is not painted on the inside but is shellaced. All parts of the dynamotor and other units of the train-control equipment, as they are removed for inspection or repair, are placed in special compartment boxes, conveniently located in the electric repair shop and so ar-



Convenient device for dismounting and reassembling generator shaft ball-bearing units



Train-control driving unit and governor case on a C. & N. W. Type-H locomotive

ranged that the possibility of losing or misplacing essential detail parts is minimized and, moreover, these parts are always conveniently at hand, which saves much time in reassembling.

The contact group in the relay case is inspected and tested, new cables being made, if necessary. The primary relay is tested, also the transmission and choke coils on the amplifier. The governor case is thoroughly cleaned and all worn gears, shafts or bearings renewed, new cable being installed, where necessary. Particular care is exercised to make sure that all cable which is oil-soaked or worn is renewed.

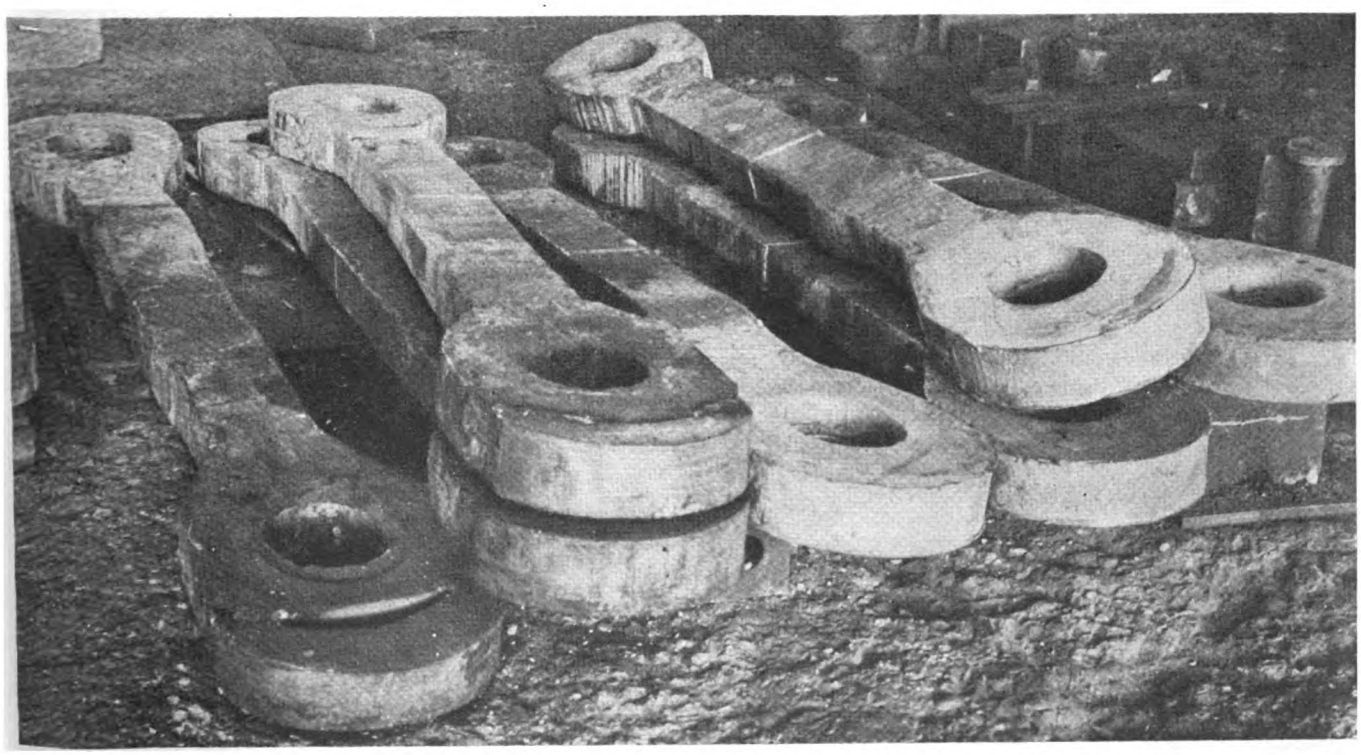
The driving unit for the train-control equipment is not overhauled at Clinton shops, but receives general repairs at Chicago shops, where all parts are thoroughly dismantled, cleaned, inspected and repaired, or replaced if necessary. The driving unit, also, is thoroughly broken in by being operated under maximum speed and for not less than eight hours.

All cab parts are tested, examined and repaired or renewed, where necessary. On completion of repairs to the train-control equipment and its replacement on the locomotive, complete speed tests and checks are made to assure that all parts are in satisfactory working condition.

Repairing Drawbars

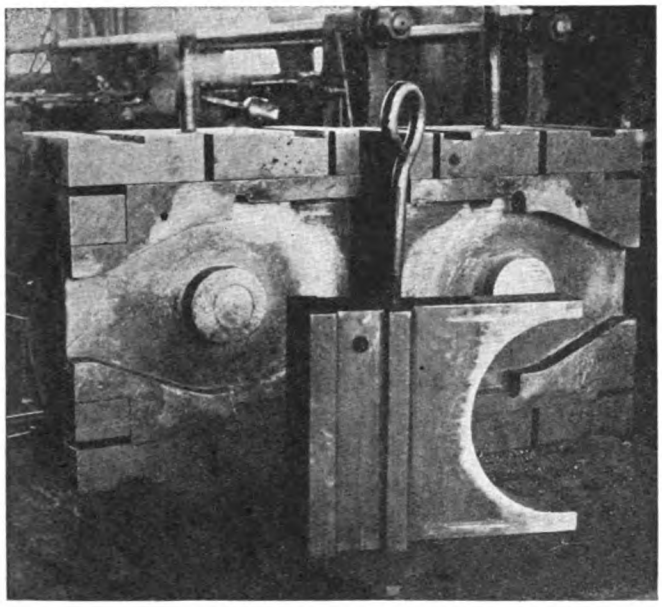
A METHOD of repairing drawbars which returns the pin holes to standard size and provides a reinforcement and improved grain flow which will tend to make drawbars even less likely to fail than when new is shown in the illustrations. The reason for this is that, by the forging process employed a flow of the grain of the metal is secured around the end of the drawbar instead of crosswise as is the case when a hole is punched in a lightly forged billet or drawbar which has been drawn out under the steam hammer.

The method of reforging drawbars, described, con-



Drawbars ready for reforging the ends (left) and after the reforging operation (right)

sists of spotwelding a taper U-shaped steel piece around the end of the drawbar, as shown on two or three of drawbars at the left in one of the illustrations. The drawbar is then heated to a welding temperature in an oil-fired furnace and the new end upset and reforged



Dies used in reinforcing and reforging drawbar ends

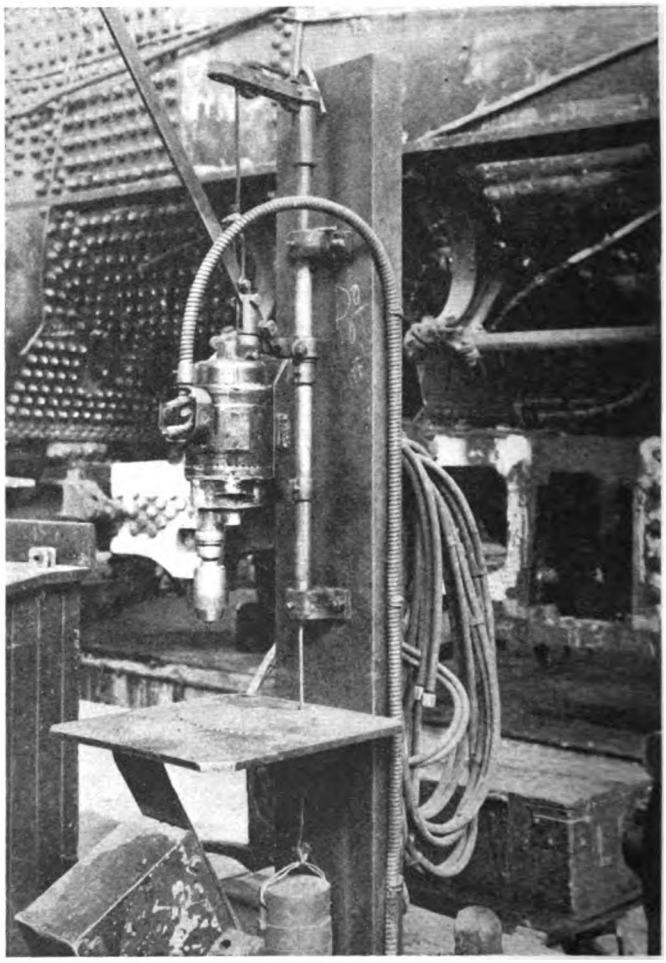
to standard size by means of special dies used in a 6-in. Ajax forging machine. The two gripping dies are shown in another illustration; also the header die in the foreground. By the action of these dies, the drawbar end is brought to the proper contour and size in one operation. Several drawbars reforged by this method are shown at the right in the illustration previously referred to.

Bench Drill In Erecting Shop

A CONVENIENT and ingenious design of electric bench drill for light drilling operations in the erecting shop is shown in the illustration. The high-speed, gear reduction-type, electric drill, with a flexible conduit to carry the electric connection, is supported by suitable slip guiding bushings on a 1-⅜-in. round hollow shaft, held in place by means of brackets bolted to a vertical 10-in. channel, the latter firmly mounted in the shop floor at a convenient location between two locomotive pits. The weight of the motor is counterbalanced by means of a cable which passes over two small, steel pulleys near the top of the channel and then down through the hollow shaft to counterweights below the table of the machine.

The work-supporting table consists of a ⅝-in. steel plate approximately 18 in. square, supported about 36 in. above the floor by being welded to the channel and to a diagonal brace which also serves to support the foot-operated electric starting switch. The electric motor has about 14 in. vertical movement on the guiding shaft and, after being placed at the proper elevation, depending upon the work to be drilled, lever feed is available for the drilling operations. Referring to the illustration, it will be noted that the lever is attached to the motor by means of a pin through a slotted extension of the handle, the fulcrum end of the lever consisting of a forged bracket with sliding connection on the vertical shaft. This fulcrum readily slides on the spindle when the motor is raised or lowered by hand, but, as soon as downward pressure is placed on the hand lever, the resultant toggle action on the fulcrum is sufficient to make it hold on the shaft and provide the desired feed for the drill.

The principal advantage of this machine is the ease and speed of adjustment to whatever drilling height is required and the fact that in any position of the drill powerful hand speed for the drilling operation is available. The location of the machine in the erecting shop saves many steps and much time formerly required in taking small parts to the machine shop for necessary drilling operations.



Bench-type electric drill with convenient hand feed

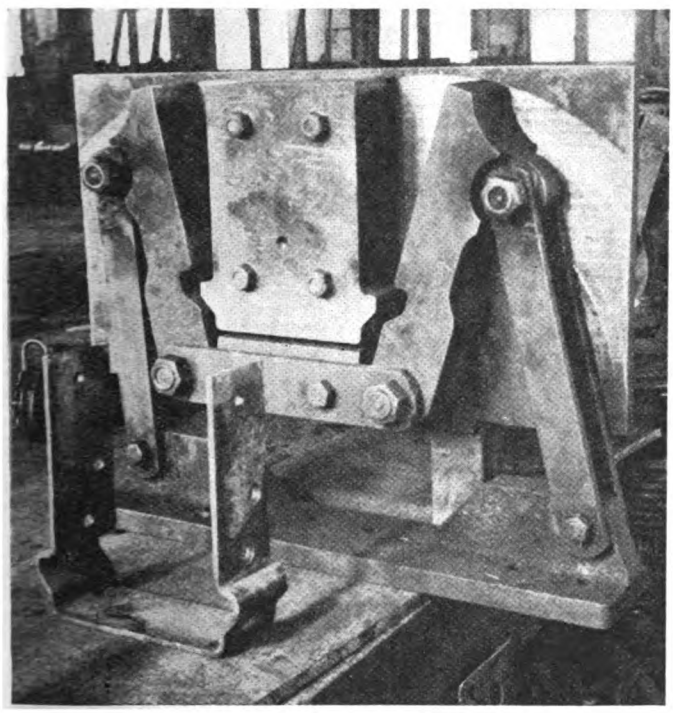
Bolster End Plate

A NEW method of making repairs to Huntoon truck bolsters has been developed, using a special steel end plate bent in a forming die, as shown in the illustration. The end castings for this type of truck bolster are made in three separate parts which are subject to breakage and wear, and the new method of repairs contemplates the replacement of these castings by a single column guide end plate, made of open-hearth

steel, ⅜ in. by 5½ in. by 46¾ in. long. The forming die, which was developed and is used at the Silvis (Ill.) shops of the Chicago, Rock Island & Pacific, is operated in a No. 28 bulldozer and forms the end plate hot in a single operation.

This forming die consists of a face plate, 1¼ in. by 24 in. by 44 in., to which is bolted a center block, 5¼ in. by 14¾ in. by 17 in., machined to the shape shown. Two wing-type die blocks, 5¼ in. square by 23 in. long, are operated by suitable lever connections from the base plate, which is a steel casting 42 in. long, bolted to the ram of the machine.

The construction of this forming die and its use to make the column guide end plate, shown in the illustration, is readily apparent.



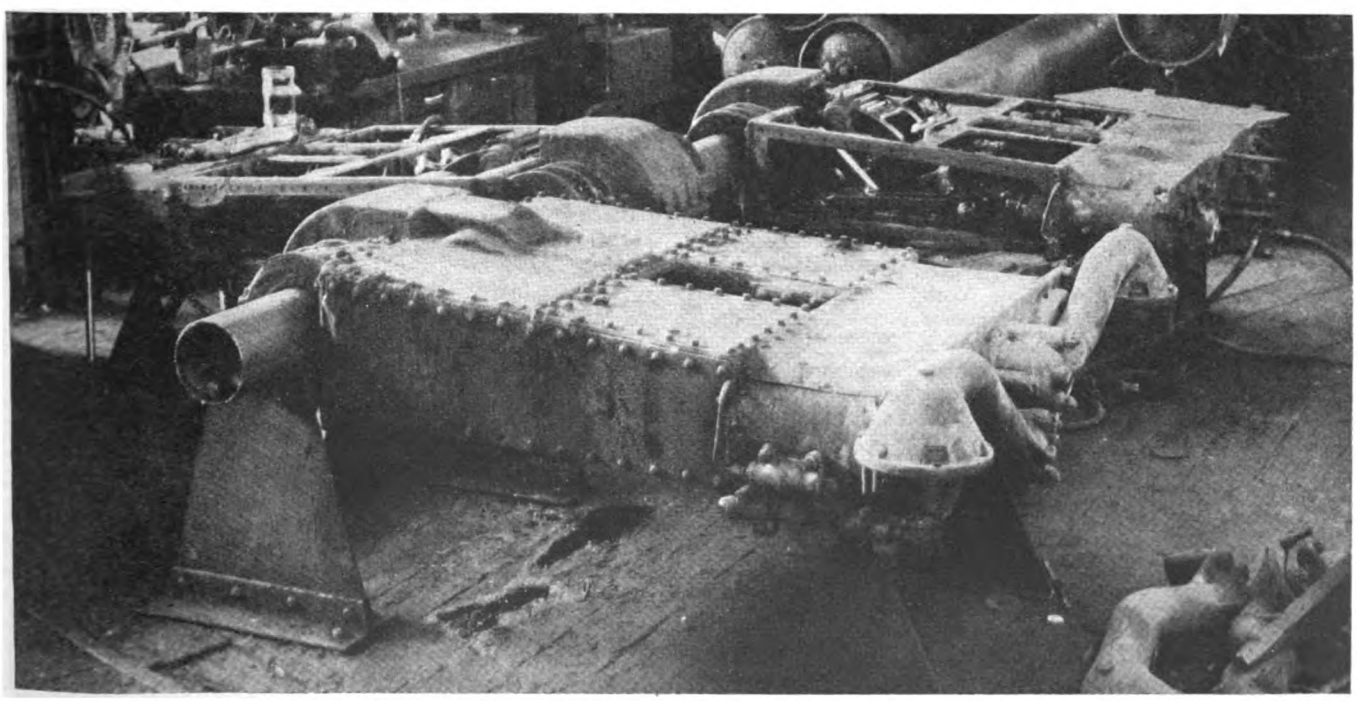
Forming die used in No. 28 bulldozer for making Huntoon column-guide end plates

Making Booster Repairs

A CONVENIENT set-up for making booster repairs at the Silvis (Ill.) shops of the Chicago, Rock Island & Pacific is shown in the illustration. The rack is designed for use in overhauling and testing boosters with air with a view to making sure that they are operating satisfactorily before being installed under the locomotive. The rack is so constructed as to hold three boosters at one time and at the same angle they will assume when in service. This permits filling the oil pan with lubricant to the desired level and seeing that all bearings run cool. Moreover, this practice provides an opportunity to make sure that all working parts, such as the pistons and valves, valve-stem packing, piston packing, rocker arms, idler gears, etc., are in first-class condition before the booster is sealed.

The rack consists of a horizontal 8-in. pipe section, supported on and welded to four ½-in. triangular steel plates which have 3-in. by 5-in. angles riveted to the bottom of each to provide an ample bearing surface on the shop floor. The outer end of each booster is supported on a light rail section, 36 in. long, also welded to two triangular steel supporting plates, flanged on the bottom to provide a substantial bearing on the floor and tapered to the width of the rail section at the top. Suitable brackets, welded in place, assure the rigidity of this support which is in effect a light horse designed to hold the cylinder end of the booster at the proper elevation.

This assembling and test rack gives ready access to all parts of the booster and an additional important advantage is the fact that it brings all of the work of repairing boosters at a height where the various operations can be handled most conveniently.



Convenient holding rack used in repairing boosters at the Silvis shops of the Rock Island

NEWS



THE PITTSBURGH & LAKE ERIE has ordered five more loco valve pilots from the Valve Pilot Corporation, New York, for installation on its freight locomotives.

this amount is for 820 coal cars which are to be assembled in its shops at Keyser. The total cost of these cars will be $1,505,000, of which the company will supply material and cash to the extent of $505,000. The balance of the loan, $900,000, will be used to purchase the 16 light weight passenger cars reported in the June issue and a Diesel engine which will probably be built in Cleveland, Ohio. In its Baltimore shops the B. & O. is converting a steam engine for use with the second train, using its own funds for that work. This contract covers the last loan to the B. & O. under allotments totalling $6,400,000.

Boston & Maine.—$2,628,000.

Gulf, Mobile & Northern.- $232,000.

Allotments for the repair or purchase of new equipment have been made as follows:

Illinois Central.—$2,000,000. Of this amount $500,000 will be used for the purchase of a streamlined train for operation between Chicago and St. Louis, Mo., on a four-hour schedule as compared with the present schedule of 6½ hr. The balance of the $2,000,000 will be used to purchase 11 Diesel locomotives. Of the 11 locomotives, 8 will be equipped with 600-hp. engines. These locomotives, which will cost $85,000 each, will be used in switching service. The three other locomotives will be equipped with 1,800-hp. motors; will cost $200,000 each, and will be used in heavy transfer switching.



This is the second loan made to the Illinois Central, the first of $10,000,000 being for the purchase of rails, fastenings and cross ties, rebuilding bridges and repairing in its own shops 12,645 freight cars, 184 passenger cars and 148 engines.

New York, New Haven & Hartford.—This road has applied to the Interstate Commerce Commission for a modification of the commission's certificate of approval of expenditures to be made with the proceeds of a loan from the P. W. A., reducing the numbers of cars to be air-conditioned from 142 to 67 and increasing the expense from $303,763 to $443,700. The company said it had been found necessary to adopt a mechanical system of air-conditioning because of inadequate icing facilities at the Grand Central Terminal and that this would increase the cost but the reduction in the number of cars is partly due to the fact that the company has ordered 50 air-conditioned coaches. It is proposed to reduce the cost assigned to the rebuilding of 139 passenger cars from $640,742 to $500,805.

Allotments for the purchase of rail or work in connection therewith have been made to the Chicago, Aurora & Elgin, $404,673; Gulf, Mobile & Northern, $31,000.

Progress in Air-Conditioning Programs

Road	No. of cars	Type of car	Type of System	Builder
A. C. L.	7[1]	Dining	.....	Safety Car Htg. & Ltg. Co.
L. & N.	8[1]	Dining	.....	Safety Car Htg. & Ltg. Co.
N. C. & St. L.	3[1]	Parlor	.....	Safety Car Htg. & Ltg. Co.
	2[1]	Dining	.....	Safety Car Htg. & Ltg. Co.
Reading—C. of N. J.	2	Pull. chair	Mech.	Pullman Car & Mfg. Corp.
	1	Pull. club	Mech.	Pullman Car & Mfg. Corp.
	2[2]	Cafe	Mech.	B. & O.—York
	5[2]	Coaches		
	2	Comb.		

[1] To be installed in shops of A.C.L.

[2] Bucket type seats will be provided in four of the coaches and new seats will be installed in the parlor portion of the cafe cars.

Mechanical Advisory Committee to Study Equipment Design

THE VARIOUS transportation studies being conducted by the Section of Transportation Service in Co-Ordinator Eastman's organization having progressed to the point where technical advice is needed in dealing with various problems connected with the modernizing of railroad operations and designs for new equipment, Mr. Eastman has appointed a mechanical advisory committee to co-operate with the section headed by L. K. Sillcox, vice-president of the New York Air Brake Company as chairman, and including also mechanical officers of several of the principal railroads and W. J. Patterson, director of the Bureau of Safety of the Interstate Commerce Commission. The railroad members are: F. H. Hardin, assistant to the president of the New York Central; F. W. Hankins, chief of motive power of the Pennsylvania; John Purcell, assistant vice-president, Atchison, Topeka & Santa Fe; and C. J. Bodemer, superintendent of machinery of the Louisville & Nashville.

Among the subjects assigned to the committee for study are cars, springs, draft gear, brakes, high-speed wheels, light materials, refrigeration, interchangeable bodies, containers, locomotives, rail, and motor cars.

P. W. A. Loans

DURING RECENT weeks contracts have been signed for the following roads:

New Equipment

CAR ORDERS

Road	No. of cars	Type of car	Builder
B. & M.—Maine Central	1[1]	3-car streamlined train	Budd-Winton
Central of Ga.	200[2]	70-ton hopper	Pullman Car & Mfg. Corp.
D. T. & I.	15[3]	55-ton steel covered hopper	Greenville Steel Car Co.
du Pont de Nemours, E. I.	2	Tank	American Car & Fdry. Co.
S.A.L.	10	Steel underframes	American Car & Fdry. Co.
	1,000[4]	50-ton, double-sheathed all-steel box	Pullman Car & Mfg. Corp.

CAR INQUIRIES

Mexican Ry.	20	40-ton auto.	.....
	30	40-ton box	.....
Nat'l Rys. of Colombia	20	Coaches	.....
	2	Diners	.....
	4	Bagg.—Mail	.....
S.A.L.	100	70-ton phosphate	.....

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of locomotive	Builder
Aliquippa & Sou.	1[5]	0-8-0	American Loco. Co.
Belt Ry. Chicago	1[6]	100-ton Diesel-elec.	American Loco. Co.—Gen. Elec.
	1[6]	100-ton Diesel-elec.	Ingersoll-Rand—Gen. Elec.

[1] In announcing this project, E. S. French, president of the Boston & Maine and the Maine Central, stated that the new train, with a carrying capacity of 150 passengers, will consist of three streamlined, shotweld stainless-steel cars, with a Winton two-cycle, 660 hp. Diesel engine in the forward car. The train will have complete buffet service and baggage space. He also said that the train will operate between Boston, Mass., Portland, Maine, and Bangor. It will be capable of a speed of 115 m.p.h. and will reduce the time on the 250-mi. run between Boston and Bangor to 4 hr. 25 min.—1 hr. 55 min. faster than at present. Financing the project is to be accomplished by asking the P.W.A. for permission to use for this purpose, instead of as originally intended, $220,000 of an allotment of $2,628,000 already made to the Boston & Maine. The train will cost about $275,000 and the remaining $55,000 of its cost will be supplied by the railroad company. The train will consist of a driving unit with baggage and express compartment, a day coach, and a parlor coach with buffet dining service. An additional car is to be built for reserve use.

[2] Subject to I. C. C. approval.

[3] For bulk cement.

[4] 300 to be built at the Richmond, Va., and 700 at the Bessemer, Ala., plants of P. C. & M. C.

[5] This locomotive will have 25-in. by 28-in. cylinders and a total weight in working order of 231,000 lb.

[6] These locomotives have been placed in switching service at the Clearing Yards, Chicago. The first is driven by a single 600-hp. Diesel engine, while the second is driven by two 300-hp. Diesel engines.

Supply Trade Notes

STANLEY H. SMITH, Midland Bank building, Cleveland, Ohio, has been appointed representative at Cleveland, for the Sellers Manufacturing Company of Chicago.

WILLITS H. SAWYER, president of Stevens & Wood, Inc., of New York, has been appointed as the administration member of the code authority for the locomotive manufacturing industry.

A. GIESL-GIESLINGEN, 4 West Thirty-first street, New York City, has resigned as United States representative of the Lentz Locomotive Poppet Valve Gear interests of Berlin and Vienna.

O. KUHLER, industrial designer specializing in factors affecting passenger appeal of railway cars, has opened an office at 136 Liberty street, New York. Henry A. Nau will be in charge of business and sales.

F. W. COPELAND, formerly vice-president and still a director of the Sullivan Machinery Company, has been elected president of the H. Channon Company, Chicago, to succeed H. G. Elfborg, deceased.

SETH H. TAYLOR, JR., has been appointed Pacific coast manager for the Lincoln Electric Company, Cleveland, Ohio. Mr. Taylor, whose headquarters will be at San Francisco, Cal., will have charge of sales and service of all Lincoln products in that territory.

JOHN C. HOPKINS has been appointed district sales manager of the Cleveland, Ohio, office of the General Refractories Company, Philadelphia, Pa. Mr. Hopkins was formerly associated with the Central furnace division of the American Steel & Wire Company, Cleveland.

ROBERT E. BROOKE, president of the Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa., has been elected chairman of the board; John E. McCauley, vice-president and general manager, has been elected president and George Brooke has been elected a vice-president.

THE AMERICAN SHEET & TIN PLATE COMPANY, Pittsburgh, Pa., has opened an additional office in the Chicago district, in the Bankers building, Milwaukee, Wis., with A. P. Bronson, assistant manager of sales, as resident manager. W. P. Andrews has been appointed assistant manager of sales in the Chicago office.

H. C. BUGHMAN, JR., secretary and treasurer of the Union Spring & Manufacturing Company, Pittsburgh, Pa., has been elected president and treasurer, to succeed L. G. Woods who died in that city on May 13, following a heart attack. A. M. McClay has been elected chairman of the board, W. M. McCabe, assistant to the vice-president, has been elected vice-president, and F. E. Schaeffer has been elected secretary.

F. WALTER BLACKEBY has been appointed district manager for the Dodge Steel Company, Philadelphia, Pa., covering the Metropolitan district of New York and also New England; Walter J. Small is now sales engineer in charge of the development of railroad specialties, both with headquarters at 6501 Tacony street, Philadelphia.

WILLIAM E. UMSTATTD, executive vice-president of the Timken Roller Bearing Company, Canton, Ohio, has been elected president, to succeed H. H. Timken, who has resigned but who continues as chairman of the board. Henry H. Timken, Jr., has been elected a vice-president of the Timken Roller Bearing Company and a vice-president of the Timken Steel & Tube Company.

THE YEAR 1934 marks the fiftieth anniversary of the founding of the Whiting Corporation, Harvey, Ill., with John Hill Whiting, founder, still active as chairman of the board. In 1884, he organized the Detroit Foundry Equipment Company to manufacture foundry equipment and other products. In 1894, the company built a portion of its present plant at Harvey and did business under the name of the Whiting Foundry Equipment Company, which name was later changed to the Whiting Corporation.

E. S. MCCLELLAND, director of personnel of the Westinghouse & Manufacturing Company, has retired after a continuous service of 53 years with Westinghouse interests. With seniority outranking all other veterans of Westinghouse, Mr. McClelland at the age of 17 started with the company in 1881 as a helper in the foundry of the Westinghouse Machine Company. He subsequently became connected with the Westinghouse Electric & Manufacturing Company and was advanced through various positions until 1920, since which time he has served as director of personnel.

R. L. TEMPLIN, chief engineer of tests of the Aluminum Company of America, has been chosen as the winner of the Charles B. Dudley medal for 1934. This medal is awarded annually by the American Society for Testing Materials to the author of the paper presented at the preceding annual meeting which is of outstanding merit and constitutes an original contribution to research in engineering materials. Mr. Templin's paper, presented in 1933, was entitled "The Fatigue Properties of Light Metals and Alloys." The medal was formally awarded at the annual meeting in Atlantic City, N. J., on June 25-29.

C. D. JENKS, president of the Chicago-Cleveland Car Roofing Company, Chicago, has been appointed president of the Railway Car Appliances Association, to fill the vacancy left by the death of W. E. Sharp, president of the Grip Nut Company. Mr. Jenks was a member of the board of directors and his place on the board will be filled by J. H. Sharp, of the Grip Nut Company. W. H. Winslow, Jr., of the firm of Defrees, Buckingham, Jones & Hoffman, has been elected secretary to succeed Frances Kamrar, resigned. The office of the secretary has been moved to 105 south LaSalle street, Chicago.

STANLEY A. KNISLEY of the advertising department of the Republic Steel Corporation, with headquarters at Cleveland, Ohio, has been promoted to the position of sales promotion and advertising manager, to succeed L. S. Hamaker, who has been elected vice-president of the Berger Manufacturing Company, a subsidiary. Mr. Knisley was formerly assistant secretary of the National Paving Brick Manufacturers' Association. From 1927 to 1933 he was director of advertising and research for the Sheet Steel Trade Extension committee which was changed in 1928 to the National Association of Flat Rolled Steel Manufacturers.

THE NATIONAL SPRAY PAINTING AND FINISHING ASSOCIATION has selected the following to serve as members of the code authority of the spray painting and finishing equipment industry: H. W. Beach, president of the Eclipse Airbrush Company, Newark, N. J.; W. B. Thompson, president of Spraco, Inc., Somerville, Mass.; W. F. Gradolph, sales manager of the DeVilbiss Company, Toledo, Ohio; J. F. Roche, executive vice-president of the Binks Manufacturing Company, Chicago; J. A. Paasche, president of the Paasche Airbrush Company, Chicago; and S. Deutsch, president of the Electric Sprayit Company, South Bend, Ind.

B. J. CROSS, who from 1921 to 1931 was associated with the engineering activities of Combustion Engineering Corporation, has rejoined the engineering department of the present organization, the Combustion Engineering Company, Inc., New York. He will be engaged in development and research work under the direction of John Van Brunt, vice-president in charge of engineering, and of Henry Kreisinger. William Lloyd, for many years identified with the design, manufacture and sales of Coxe stokers, has again become associated with the engineering department of Combustion Engineering Company, Inc.

THE RAILWAY STEEL-SPRING COMPANY, a wholly-owned subsidiary of the American Locomotive Company since 1926, has been consolidated with the parent company and the business conducted by the Railway Steel-Spring Company will hereafter be carried on by the American Locomotive Company, Railway Steel-Spring division. In the consolidation the American Locomotive Company acquired the assets of the Railway Steel-Spring Company, including the manufacturing plants, sales orders and contracts, and the operating, sales and administrative personnel, and assumed all the liabilities, including contracts and orders for the purchase of materials and supplies. Alexander S. Henry, president of the Railway Steel-Spring Company, has been appointed vice-president of the American Locomotive Company, Railway Steel-Spring division.

THE RAILWAY CAR BUILDING INDUSTRY has selected the following members as its code authority: Chairman, John F. MacEnulty, general sales manager of the Pressed Steel Car Company, New York; C. A. Liddle, president of the Pullman Car & Manufacturing Corporation, Chicago; Charles J. Hardy, president of the American Car & Foundry Company, New York; Lester N. Selig, president of the General American Transportation Corporation, Chicago; R. K. Weber, president of the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill.: Frank L. Fay, president of the Greenville Steel Car Company, Greenville, Pa.; and F. E. Symons, president of the Ralston Steel Car Company, Columbus, Ohio.

ARTHUR S. GOBLE, for many years district manager at St. Louis, Mo., of the Baldwin Locomotive Works, has again joined this company's sales staff as a member of the Philadelphia, Pa., district organization, having on June 1 taken over the territory formerly covered by Charles E. Hale, deceased. Henry Blanchard, formerly of the Chicago district office, is now located in the Eddystone, Pa., office as a sales correspondent in connection with both foreign and domestic inquiries. Mr. Goble



Arthur S. Goble

in 1904 completed a course in chemical engineering at the University of Illinois, and during the same year entered the service of the Chicago & North Western as assistant to the chemist and engineer of tests. In 1911 he left that road to enter the sales departments of the Baldwin Locomotive Works and the Standard Steel Works Company, in the New York office, later serving in the Chicago office. During the last 14 years of his service with these companies, he was district manager of the St. Louis, Mo., office in charge of sales in the southwestern section of the United States. He left that service in August, 1932, and subsequently was vice-president of the Hanna Stoker Company with duties including jurisdiction over sales.

L. S. HAMAKER, sales promotion manager of the Republic Steel Corporation, Youngstown, Ohio, has been appointed vice-president and general manager of the Berger Manufacturing Company, Canton, Ohio, a subsidiary, to succeed J. B. Montgomery, II, who resigned on June 1. Mr. Hamaker entered the sales department of the Berger Manufacturing Company in 1919, later transferring to the advertising department. In 1925, he became advertising manager of the United Alloy Steel Corporation. With the for-



L. S. Hamaker

mation of the Central Alloy Steel Corporation by the merging of the United Alloy Steel Corporation with the Central Steel Company in 1926, he was appointed advertising manager of the new company. When the Republic Steel Corporation was organized in 1930, he continued in that capacity. He was later appointed sales promotion manager and continued in charge of advertising.

JOHN E. LONG has been appointed mechanical engineer of the Franklin Railway Supply Company, Inc., with headquarters at the Chicago office. Mr. Long was born in 1899 and was graduated from Purdue



John E. Long

University in 1923. Prior to his graduation he was employed in various capacities by the Pennsylvania, the Baltimore & Ohio and the Atchison, Topeka & Santa Fe. In 1923 he went with the Lima Locomotive Works, Incorporated, remaining with that company for 11 years until his appointment as mechanical engineer of Franklin Railway Supply Company. While with Lima, Mr. Long was in the calculating, service, engineering and sales departments and had an extensive experience in special design work and in locomotive testing. He also engaged in the study of operating conditions on various roads with a view to applying the most efficient designs of locomotives to the specific operations.

THE HOLLAND COMPANY, McCormick building, Chicago, has been incorporated by Cyrus J. Holland.

FRANK W. BLAKE, representative of the Garlock Packing Company, Palmyra, N. Y., with headquarters at Omaha, Neb., has been transferred to Chicago.

SAMUEL E. HACKETT, who has been elected president of the Jones & Laughlin Steel Corporation, with headquarters at Pittsburgh, Pa., left the service of the Joseph T. Ryerson Company in 1916, to become district sales manager and manager of the Chicago warehouse of the Jones & Laughlin Steel Corporation. In 1918, he was transferred to Pittsburgh, Pa., and appointed general manager of sales. Since



Samuel E. Hackett

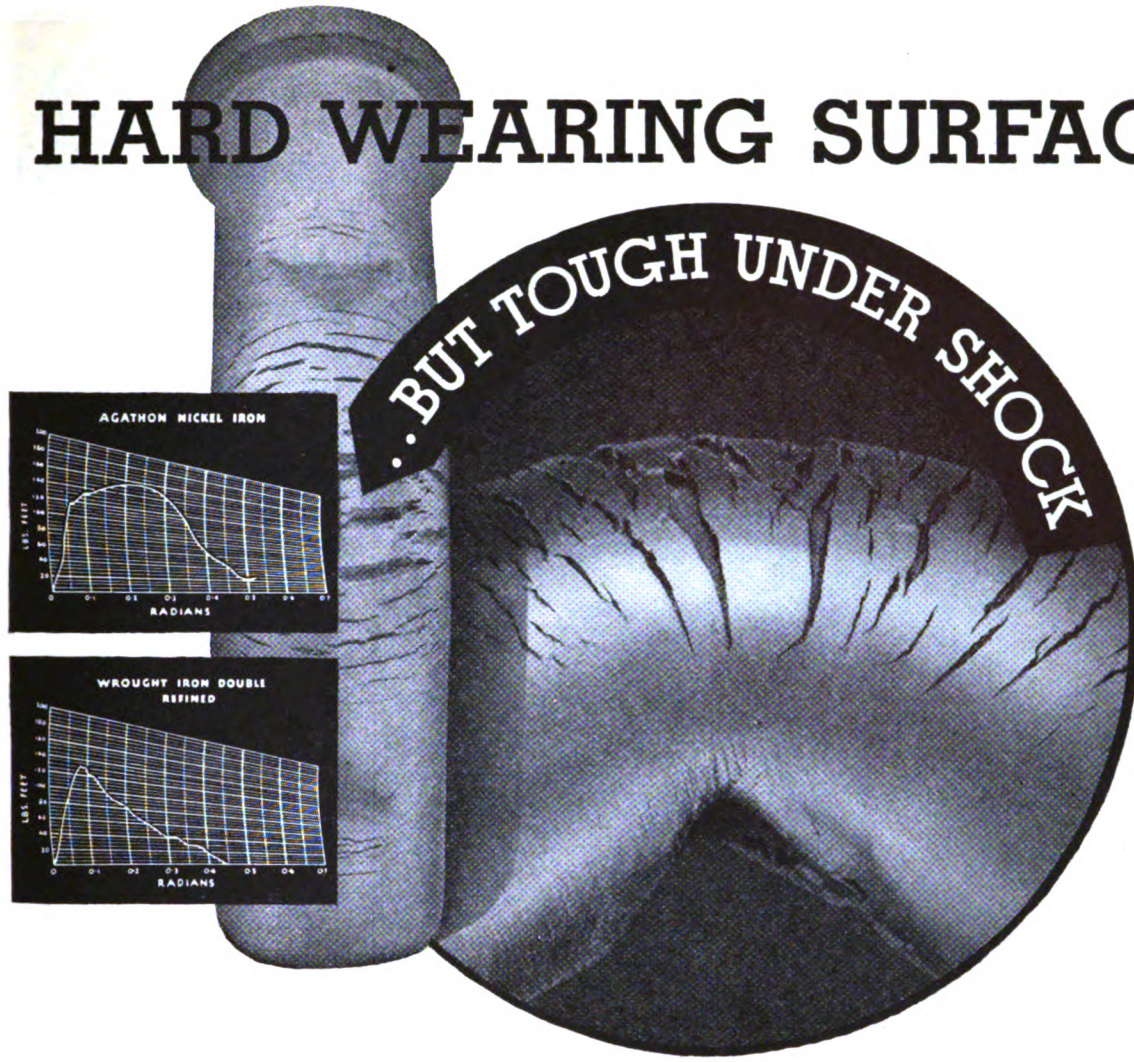
January, 1923, Mr. Hackett has served as vice-president in charge of sales and now becomes president of the same company.

Permanent Code Authority for Machinery & Allied Products Industry

National Recovery Administrator Hugh S. Johnson has approved the method of selection and recognized the personnel of the permanent basic code authority for the machinery and allied products industry.

The members are:—W. S. Shipley, president, York Ice Machinery Corporation, York, Pa.; W. C. Dickerman, president, American Locomotive Company, New York City; Leo W. Grothaus, assistant to the president, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.; Paul C. De Wolf, vice-president, Browne & Sharpe Manufacturing Company, Providence, R. I.; P. C. Brooks, executive vice-president, Fairbanks, Morse & Co., Chicago, Ill.; George P. Torrence, president, Link-Belt Company, Chicago, Ill.; N. W. Pickering, president, Farrel-Birmingham Company, Ansonia, Conn.; Robert E. Friend, president, Nordberg Manufacturing Company, Milwaukee, Wis.; George H. Houston, president, Baldwin Locomotive Works, Philadelphia, Pa.; A. M. Mattison, president, Mattison Machine Works, Rockford, Ill.; Guy A. Wainwright, president Diamond Chain Manufacturing Company, Indianapolis, Ind., and Denis F. O'Brien, president, A. P. Smith Manufacturing Company, East Orange, N. J.

A HARD WEARING SURFACE



Many steels will take a hard surface but their cores are brittle. Many other steels are tough at the core but can not be surface hardened satisfactorily. » » » Agathon Nickel Iron now combines a hard surface to resist wear with a tough, strong core to resist shocks. » » » It is therefore the ideal material for case-hardened parts. Agathon Nickel Iron has a reputation for toughness. Observe the test illustrated above and note the toughness of the Agathon Nickel Iron under repeated hammer blows. » » » This modern alloy iron is ideal for all case-hardened work. There are no slag spots or seams, and warping is almost negligible. Use it for all case-hardened pins and bushings.

Toncan Iron Boiler Tubes, Pipe, Plates, Culverts, Rivets, Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel.

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES Reg. U. S. Pat. Off. YOUNGSTOWN, OHIO

AGATHON NICKEL IRON

Obituary

SYDNEY R. RECTANUS, vice-president of the American Rolling Mill Company, Middletown, Ohio, died suddenly on June 22.

H. C. BUTLER, vice-president, Montreal Locomotive Works, Ltd., died suddenly at his home in Westmount (Montreal), Que., on June 18.

GEORGE M. CROWNOVER, general superintendent of the Oxweld Railway Service Company, Chicago, and superintendent of motive power of the Chicago Great Western at Oelwein, Iowa, until 1913, died in Chicago on June 5.

WILLIAM E. SHARP, president of the Grip Nut Company, Chicago, and long prominent in railway supply circles, died in that city on June 4, following a short illness. Mr. Sharp was born in Warren, Huntington county, Ind., on June 25, 1870, and entered railway service as an apprentice at the Huntington, Ind., shops of the Erie in 1889. In 1893 he was appointed general foreman of the locomotive and car



William E. Sharp

department of the Erie at Chicago, which position he held until 1898, when he resigned to become engineer of car construction of the Armour Car Lines, Chicago. In 1902 he was appointed acting superintendent of these lines and later became general superintendent in charge of design, building and maintenance of all this company's cars. He resigned in 1911 and in the following year was elected vice-president of the Grip Nut Company. He was elected president in 1917. Mr. Sharp took a keen interest in railway and railway supply association work. He was one of the organizers of the Car Foremen's Association of Chicago, which he served in several offices, including that of president. He was a past president of the Western Railway Club. At the time of his death he was president of the Railway Car Appliances Association, which was recently organized to administer the N. R. A. code of the railway car appliances industries. He was also a member of the executive committee and the governing board of the Railway Business Association, of which at one time he was a vice-president.

HARRY L. MCCAULEY, district sales manager at Milwaukee, Wis., of the Inland Steel Company, died from drowning on June 24 at the age of 44. After working in the Gary, Ind., sheet mills of the American Sheet & Tin Plate Company, Mr. McCauley was employed in May, 1920, at the Chicago office of the Inland Steel Company. On May 1, 1924, he was transferred to the Milwaukee office, as assistant district sales manager and in March, 1928, he was promoted to district sales manager.

ROBERT D. CAMPBELL, senior vice-president and a director of the Allegheny Steel Company, Pittsburgh, Pa., died from a heart attack on June 21 in a hospital at Orillia, Ont., at the age of 65. Mr. Campbell took a prominent part in Pittsburgh industrial circles for the past 25 years and was also a director of the Edward G. Budd Manufacturing Company.

Personal Mention

General

S. M. GOLDEN, assistant to the president of the Chicago Great Western, has assumed jurisdiction over the mechanical, maintenance of way and stores departments in addition to his other duties.

G. G. LYNCH, mechanical engineer-equipment of the Atlantic Coast Line, with headquarters at Wilmington, N. C., has been appointed assistant to general superintendent of motive power, to succeed R. J. Turnbull, deceased. Mr. Lynch was educated in the Wilmington high school and at North Carolina State College, from which he graduated in 1905. He entered the service of the Atlantic Coast Line as mechanical draftsman in June, 1905, and two years later was appointed supervisor of water softening plants for the system. He was mechanical draftsman in the office of the general superintendent of motive power from December, 1909, to September, 1918, when he was appointed chief draftsman. He became assistant mechanical engineer in January, 1925, and was promoted to the position of mechanical engineer-equipment in September, 1929.

W. Y. CHERRY, superintendent of motive power of the New Jersey division of the Pennsylvania, has been appointed general superintendent of motive power of the New York Zone, with headquarters at New York. Mr. Cherry was born at Fort



W. Y. Cherry

Wayne, Ind., on June 21, 1873. He entered the service of the Pennsylvania on June 1, 1888, as a boilermaker apprentice. He later served as machinist apprentice, machinist and foreman machine shop gang and in December, 1907, was appointed machine shop foreman. He became enginehouse foreman in January, 1912, serving in that position until February, 1917, when he was assigned to the office of the general superintendent of motive power, Lines West, as motive power inspector. Mr. Cherry was appointed master mechanic of the Grand Rapids & Indiana (part of the P.R.R.) in March, 1917, superintendent of motive power of the Lake division of the P.R.R. at Cleveland, Ohio, in March, 1920. He became superintendent of motive power of the Long Island (P.R.R. affiliate) in February, 1928, and when the New York Zone of the Pennsylvania was created in October of that year, he was appointed general superintendent of motive power of that zone. This position was abolished in May, 1932, and Mr. Cherry became superintendent of motive power at New York.

Master Mechanics and Road Foreman

G. A. JORDAN, master mechanic of the Union Pacific at Denver, Colo., has been transferred to the position of master mechanic at Cheyenne, Wyo.

WILLIAM NOLAN, district foreman of the Union Pacific at Council Bluffs, Iowa, has been promoted to the position of master mechanic, with headquarters at Denver, Colo.

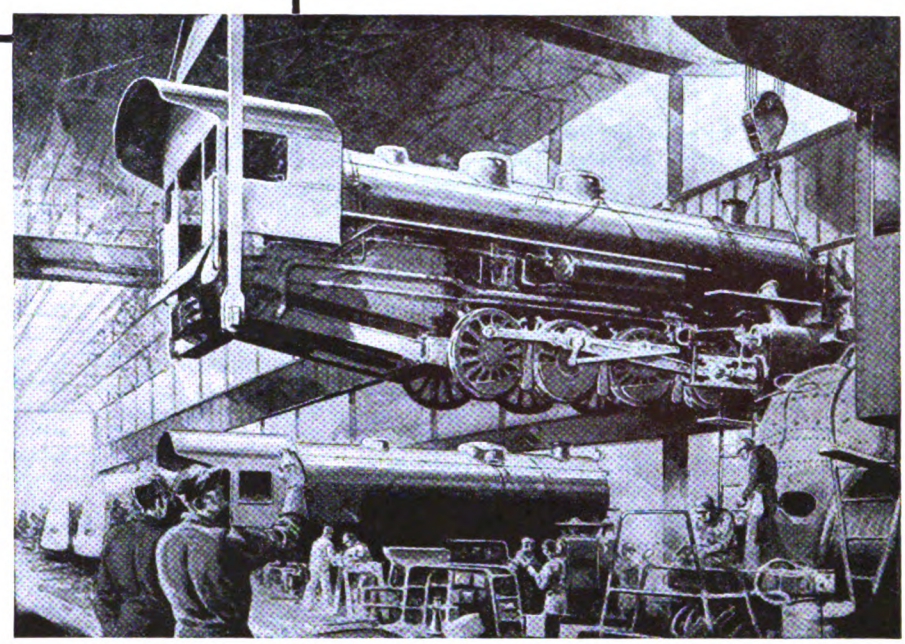
C. O. SHULL, assistant master mechanic of the Pittsburgh division of the Pennsylvania, has been promoted to the position of master mechanic of the Chicago Terminal division.

D. K. CHASE, master mechanic of the Chicago Terminal division of the Pennsylvania, has been transferred to the Pittsburgh division, with headquarters at Pittsburgh, Pa., succeeding C. B. Gray, deceased.

WARREN P. HARTMAN, who has been appointed master mechanic of the Atchison, Topeka & Santa Fe, with headquarters at Slaton, Tex., was born on February 1, 1891. He attended primary and high schools at Longmont, Colo., until 1909, when he entered the University of Colorado, from which he received the degree of M.E. in 1914. He became a special apprentice on the Santa Fe at La Junta, Colo., on July 1, 1914; apprentice instructor, June 1, 1917; erecting foreman at Raton, N.M., November 12, 1917; general erecting foreman at La Junta, May 1, 1920; general erecting foreman at Raton, June 1, 1921; night assistant enginehouse foreman, October 8, 1921; day assistant enginehouse foreman, January 1, 1923; acting general enginehouse foreman at Albuquerque, N.M., December 13, 1923;

(Turn to next left hand page)

THE COST OF THE PART IS ONLY A SMALL PART OF THE COST



Any locomotive accessory must withstand service that is the severest in the world.

If, added to this, replacement parts of inferior manufacture are used, the satisfactory performance of that accessory is put in double jeopardy.

The first costs of such inferior replacement parts may be lower, but they are not lower in economy. More of such parts will be used with resultant failure and labor loss in tearing down the device.

Replacement parts for Franklin Devices should be furnished by us as they are guaranteed to be absolutely interchangeable with like parts, will require minimum labor in installing, and will give maximum service life at minimum cost.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

night enginehouse foreman at Raton, March 11, 1924; general enginehouse foreman at Albuquerque, July 10, 1924, and fuel supervisor at Amarillo, Tex., on December 1, 1930. He became master mechanic at Slaton on January 1 of this year.

Car Department

G. C. MARTIN has been appointed coach-yard foreman of the Texas & Pacific, with headquarters at Fort Worth, Tex.

D. T. PERRY, coach foreman of the Texas & Pacific at Fort Worth, Tex., has been promoted to the position of general car foreman.

E. C. TRAPP, painter foreman of the Union Pacific at Omaha, Nebr., has been transferred to the position of painter foreman at Pocatello, Idaho.

W. W. HOLLAND, assistant car foreman of the Union Pacific at Cheyenne, Wyo., has been transferred to the position of assistant car foreman at Pocatello, Idaho.

H. W. HEATH, repair track foreman of the Union Pacific at Cheyenne, Wyo., has been promoted to the position of car foreman, with headquarters at Laramie, Wyo.

B. F. RUGG has been promoted to the position of car foreman of the Texas & Pacific, with headquarters at Fort Worth, Tex. Mr. Rugg was formerly at Longview, Tex.

A. ROUTON has been promoted to the position of car foreman of the Texas & Pacific, with headquarters at Fort Worth, Tex. Mr. Routon was formerly at Texarkana, Tex.

JAMES F. FITZGERALD, car foreman of the New York, New Haven & Hartford at Springfield, Mass., has been promoted to the position of general car foreman, with headquarters at Dover street, Boston, Mass.

Shop and Enginehouse

A. L. SAY, machinist of the Union Pacific at Pocatello, Idaho, has been promoted to the position of drop pit foreman.

J. H. KOHLER, boilermaker foreman of the Northern Pacific at Livingston, Mont., has been promoted to the position of night enginehouse foreman at Pasco, Wash.

N. BRENCHLEY, machinist inspector of the Union Pacific at Green River, Wyo., has been promoted to the position of assistant enginehouse foreman.

C. B. CAMP, enginehouse foreman of the Texas & Pacific at Fort Worth, Tex., has been promoted to the position of general foreman, locomotive department.

S. C. SMITH, district foreman of the Union Pacific at Green River, Wyo., has been transferred to the position of district foreman at Pocatello, Idaho.

F. L. JOHNSON has been promoted to the position of boilermaker foreman of the Northern Pacific at Livingston, Mont. Mr. Johnson was transferred from Wallace, Idaho.

J. P. NELSON, machine foreman of the Union Pacific at Evanston, Wyo., has been promoted to the position of night enginehouse foreman, with headquarters at Green River, Wyo.

T. H. EVANS has been promoted to the position of general locomotive foreman at the Bellmead shops of the Missouri-Kansas-Texas at Waco, Tex.

A. R. NELSON, engine inspector of the Union Pacific at Pocatello, Idaho, has been promoted to the position of day enginehouse foreman.

H. W. RAIDY, machinist of the Union Pacific at Pocatello, Idaho, has been promoted to the position of night enginehouse foreman.

J. A. BOHACEK, erecting gang foreman of the Union Pacific at Omaha, Nebr., has been transferred to the position of erecting gang foreman at Pocatello, Idaho.

H. H. JONES, night enginehouse foreman of the Union Pacific at Green River, Wyo., has been promoted to the position of division foreman.

W. R. MONROE, boiler inspector of the Union Pacific at Pocatello, Idaho, has been promoted to the position of enginehouse boiler foreman.

E. J. SEDLACEK, machinist inspector of the Union Pacific at Green River, Wyo., has been promoted to the position of drop pit foreman.

WILLIAM OBERG, enginehouse boiler foreman of the Union Pacific at Cheyenne, Wyo., has been transferred to the position of general boiler foreman at Pocatello, Idaho.

Purchasing and Stores

P. A. HOLLAR, coal agent of the Pennsylvania, succeeds E. J. Lamneck as fuel purchasing agent at Philadelphia, Pa.

T. W. DURHAM has been appointed purchasing agent of the Lake Superior & Ishpeming, with headquarters at Marquette, Mich.

E. J. LAMNECK, fuel purchasing agent of the Pennsylvania at Philadelphia, Pa., succeeds C. E. Walsh as purchasing agent at Philadelphia.

E. R. BRINTON, acting general storekeeper of the Chicago Great Western, has been appointed general storekeeper, with headquarters as before at Oelwein, Iowa.

F. V. BURTON, assistant general storekeeper of the Canadian National at Winnipeg, Man., has been transferred to Toronto, Ont., to replace S. E. Keillor, who, in turn, has been transferred to Winnipeg.

C. T. COLEMAN, general storekeeper of the Atlanta, Birmingham & Coast, with headquarters at Fitzgerald, Ga., has been appointed purchasing agent with headquarters at Atlanta, Ga.

F. C. TURNER, traveling storekeeper of the Northern Pacific, with headquarters at Parkwater, Wash., has been promoted to assistant general storekeeper with headquarters at South Tacoma, Wash., to succeed S. H. Robson, who has retired under the pension rules of the company.

Obituary

J. R. SEXTON, who retired in 1930 as mechanical superintendent on the Western Lines of the Atchison, Topeka & Santa Fe at La Junta, Colo., died suddenly on May 4.

ARTHUR KNAPP, inspection engineer of rails, wheels and structural steel for the New York Central, with headquarters in New York, died suddenly in that city on May 3 while waiting to board a train for Pittsburgh. For the past six years he had been chairman of the Committee on Wheels, Mechanical Division, A.R.A. Mr. Knapp was 50 years old.

MONTGOMERY SMITH, who retired as assistant general purchasing agent of the Pennsylvania in August, 1929, died in Philadelphia on June 5, after a short illness. Mr. Smith was 71 years of age. He entered the service of the Pennsylvania in 1879 and served in various positions in the purchasing department of that road until 1924, when he was appointed purchasing agent. He was later promoted to the position of assistant to the general purchasing agent, and in 1928 he became assistant general purchasing agent, in which capacity he served until his retirement in August, 1929.

JOHN B. HURLEY, general road foreman of engines and general fuel supervisor of the Wabash, died suddenly at Kansas City, Mo., on July 5 at the age of 71 years. Mr. Hurley entered railway service in 1882, as a locomotive fireman on the Chicago, St. Paul, Minneapolis & Omaha, being advanced to engineman in 1887, in which capacity he later served on several



J. B. Hurley

other railroads. In 1902, Mr. Hurley became connected with the International Correspondence Schools as an instructor, later accepting a similar position with the Southern School of Railway Science. He reentered railway service in 1910 as general road foreman of engines of the Wabash and in 1913 he was given the added duties of general fuel supervisor. Mr. Hurley was a past president of the International Railway Fuel Association (1920-21), and of the Traveling Engineers Association (1926-27).

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

August, 1934

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices,
30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: Terminal Tower

Washington: 832 National Press Bldg.

San Francisco: 58 Main St.

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Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States and possessions: 1 year, $3; 2 years, $5. Canada, including duty: 1 year, $3.50; 2 years, $6. Foreign countries: 1 year, $4; 2 years, $7.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.

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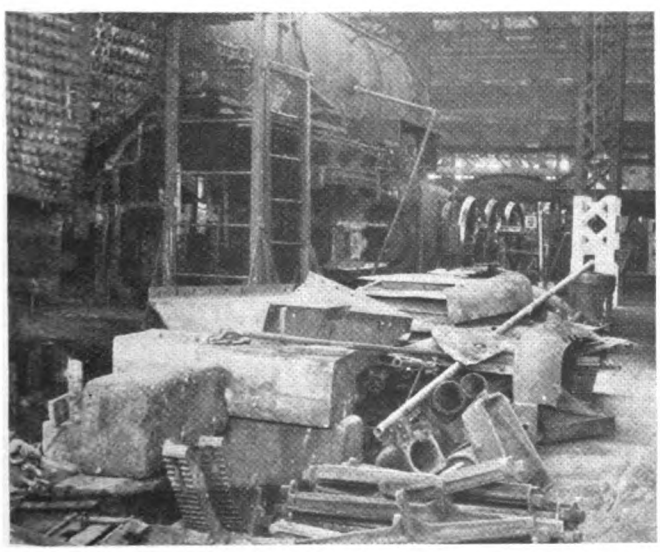
Progressive Spot System On the Lehigh Valley

The application of the progressive system in the Sayre, Pa., locomotive shop is one of the first efforts to apply modern straight-line methods to the transverse type of shop

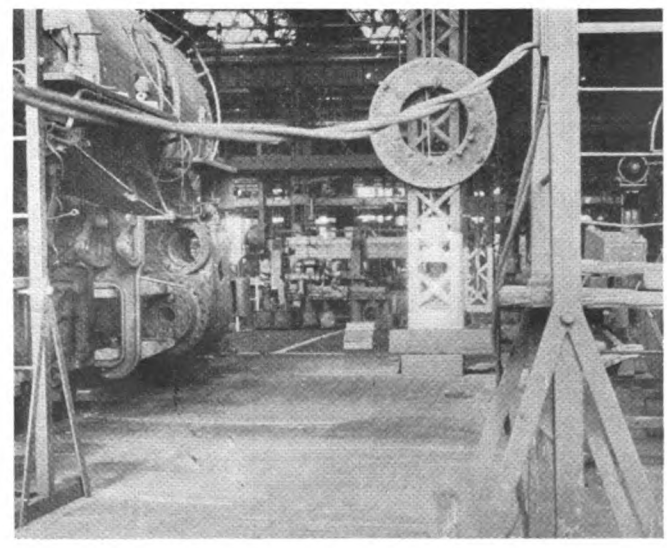
IN an effort to meet the ever-increasing demand for improved service and higher operating speeds the mechanical department of the Lehigh Valley found it necessary to assure a higher quality of workmanship in locomotive repairs and a more thorough inspection of locomotive parts during the progress of the work in the shop. During the past few years practically all of the major heavy locomotive repair work on that system has gradually been concentrated at the system's shops at Sayre, Pa. The Sayre shop is of the transverse type, having erecting bays on both sides of the shop and light and heavy machine bays in between. The shop is served by an outside turntable at the main entrance rather than by a transfer table.

In spite of the fact that the facilities at Sayre have been continually improved and progress has been made over a period of years in the method of operating the shop, it was found, after a thorough study was made of the demands on the shop under present conditions, that the desired objectives in locomotive repair work could not be reached under the conventional system of operating this type of shop; namely, that of spotting locomotives on erecting pits and performing all of the work from stripping to reassembling in the one position. This system made it necessary particularly to store parts adjacent to locomotives undergoing repairs in such a manner as to result in considerable congestion in the erecting shop, plus the fact that it required the transportation of locomotive parts to be repaired or to be applied over long distances to and from the several departments in the shop.

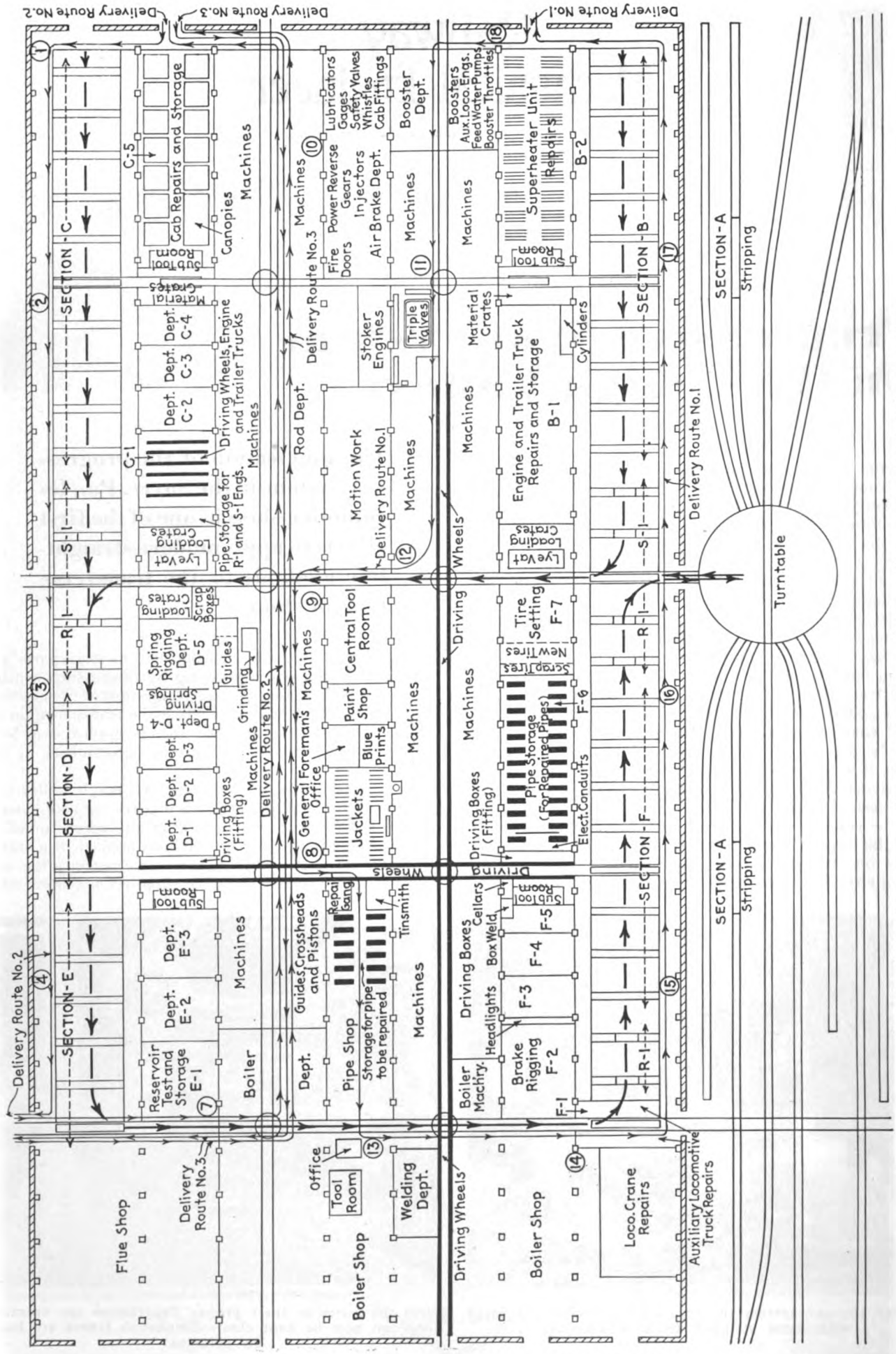
To meet present-day conditions the Lehigh Valley mechanical department developed a progressive spot system of locomotive repairs which is, after all, merely an adaptation of progressive repair methods applied to a transverse type of shop. While up to quite recently the volume of work handled at Sayre shop has not been suffi-



Under the old system the erecting pits were congested with parts stripped from locomotives



With the parts in their proper department the erecting floor can now be kept clear—Smokebox fronts are hung on columns



Layout of the Sayre locomotive shop showing various sec tions and material delivery routes

cient to permit conclusions to be drawn as to the ultimate advantages of this progressive system, it is true that during the past year that it has been in operation there are many indications that the new method of handling the work of repairing locomotives has resulted in sufficient advantage to justify the change that has been made. The changes that were necessary in the shop incident to the actual installation of the progressive system extended over a period of about seven months.

Generally speaking, the principal difference between the progressive spot system of repairing locomotives in this shop and the conventional system formerly in use is that, whereas materials and workmen went to the locomotive which was in a fixed location, the locomotive now moves from one specialized location to another and the re-arrangement of departments, and to a certain extent facilities, has been such that under the present system, in so far as physically possible, each department and facility has been located at the shortest possible distance from the point in the shop where the repaired parts are reapplied to the locomotive as it passes through the shop in the process of repair and assembly. One of the handicaps of the former system was that there was possible no systematic method of storing locomotive parts while awaiting repair or after having been repaired, plus the fact that the storage locations then available were not only in locations where, in many cases, it was highly undesirable to have stored parts, but they were also of inadequate capacity.

This applied particularly to such classes of material as jackets and piping. The old jacket storage, for example, had only nineteen sections, which was entirely inadequate, whereas the new storage location is equipped with

Table I— Work Handled in Major Sections

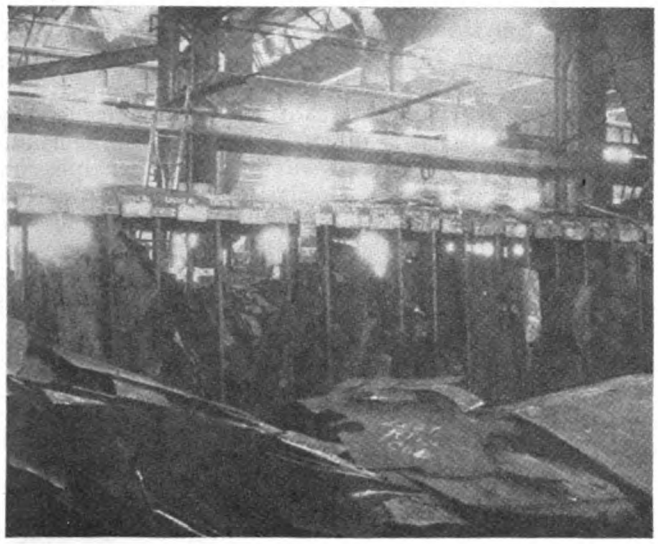
Section	Operation	Work Performed
A	Stripping	Locomotive completely stripped outside of shop excepting removal of driving wheels, engine and trailer trucks.
B	Heavy boiler work	Fireboxes, flues, throat, flue and side sheets, boiler courses, cylinder work, cylinder and valve-chamber bushings, frame work, frame braces, deck castings, pedestal binders, waist sheets, furnace and deck sheets, layout shoes and wedges, guide yokes, apply throttle, steam and dry pipes, auxiliary dome, arch tubes, smokebox, fronts, stacks, cinder pockets, dome covers, guide yoke and knees, sand box, superheater header.
C	Light boiler work	Flues, units, patches, stay and crown bolts, caps, cylinder work, cylinder and valve-chamber bushings, frame work, frame braces, deck castings, pedestal binders, waist sheets, furnace and deck sheets, layout shoes and wedges, guide yokes, apply throttle, steam and dry pipes, auxiliary dome, arch tubes, smokebox fronts, stacks, cinder pockets, dome covers, guide yoke and knees, sand box, superheater header.
D	Boiler testing	Apply pressure fittings—test boiler—apply jacket, lagging, cab, canopy, dome casings, blowout cylinders and steam passages, apply air reservoirs, air-pump brackets, ash pans, boiler mountings, buffers, couplers, drawbars, fire-doors, flagstaffs, grate bearers, grate-shaker, fulcrums, cylinder jacket, power reverse bracket, reverse-shaft counterbalance, reverse-shaft, running boards, throttle and reverse levers, boiler checks, safety valves, steam turret, steam-pipe casings, springs, equalizers and saddles, shoes and wedges, stoker and conveyor, valve-gear frame, water columns, whistle, brake cylinders, deck boards—sheets, blow-off cock, miscellaneous small brackets.
E	Assembling	Wheel engine—apply pistons, valves, guides, crossheads, rods, motion work, air pumps, auxiliary locomotive and booster throttles, booster pipes, blower connections, bumper beams, cylinder heads and casings, cutting lever, damper valves, exhaust stand and nozzle, feedwater heater and pump, mechanical lubricator, pedestal binders, pilot and steps, power reverse gear, smoke-box braces, fire-door shields—grate lever locks—shields, hand railing and safety appliances, smoke-box door, steam chest cover and casings, valve chamber heads and casings, air-brake appliances.
F	Finishing	Cab work, train control, electrical work, set valves, all pipe work, apply apron, bell, brake rigging, brick arch, cab fittings, cylinder cocks and rigging, draft applicances, drifting valve, flue blower, generator, grates, headlight, injectors, markers, sanders, stack extensions, water glasses, test air, painting and general finishing up of engine.

Reference Key to Departments Not Otherwise Identified in the Layout on the Opposite Page

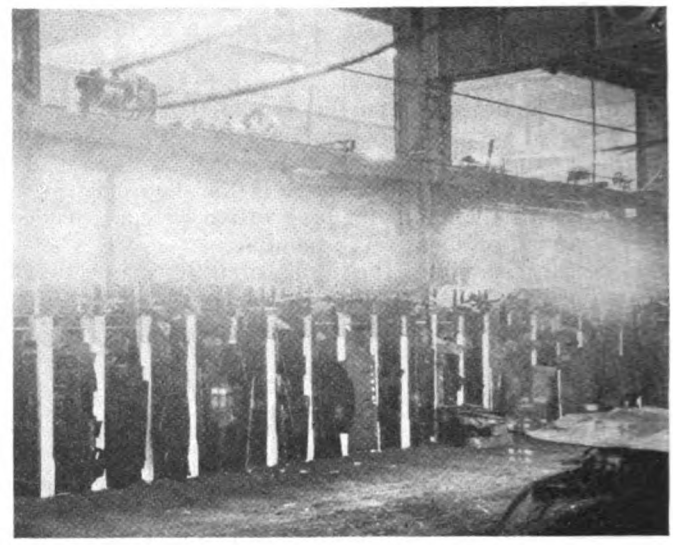
Dept. or section	Parts or Work Handled
C-2	Shoes and wedges and binders.
C-3	Steam pipes, throttle, dome and turrets.
C-4	Brake cylinders, frame braces, deck and center castings, guide yokes, drawbars, cylinders.
D-1	Miscellaneous small brackets, deck boards and sheets, firedoor shields, shaker locks and guards.
D-2	Stoker department—Firedoors, shaker castings.
D-3	Special tools and appliances.
D-4	Stacks, smokebox doors, sand boxes.
E-2	Hand rails, safety appliances, pilots, steps, smokebox braces, running boards, dome castings, flue blowers, operating levers.
E-3	Steam-pipe casings, valve-chamber heads and casings, cylinder-head casings, valve-gear frame, exhaust pipes and nozzles, couplers, coupler pockets, steam-chest covers and casings.
F-1	Auxiliary locomotive truck repairs.
F-3	Headlight generators, train control, bells.
F-4	Draft appliances, stack extensions.
F-5	Grates, fire brick and grate rods.

Table II—Movement of Parts in the Shop

Locomotive part	Delivered to department or section	Repaired in department or section	Stored in department or section	Applied in department or section
Air-brake appliances	Air brake	Air brake	Air brake	E
Air pumps	Air brake	Air brake	D-4	E
Air-pump bracket	D-1	D-1	D-1	D
Air reservoirs	Lye vat	E-1	E-1	D
Apron	F-4	F-4	F-4	F
Arch tubes	Pipe	Pipe	Pipe	B and C
Ash pans	Boiler	Boiler	Boiler	D
Ash-pan supports	Boiler	Boiler	D-1	D
Auxiliary dome	C-3	C-3	C-3	B and C
Aux. loco truck	F-1	F-1	F-1	Tank
Aux. loco. engine	Lye vat	Booster	Booster	F-1
Aux. loco. throttle	Booster	Booster	Booster	E
Bells	Lye vat	F-3	F-3	F
Bell stand	Lye vat	F-3	F-3	F-3
Bell ringers	Air brake	Air brake	F-3	F-3
Blow-off cock	Air brake	Air brake	Air brake	D
Booster engine	Lye vat	Booster	B-1	B-1
Booster throttle	Booster	Booster	Booster	E
Booster pipes	E-3	E-3	E-3	E
Boiler check	Air brake	Air brake	Air brake	D
Brake cylinders	C-4	C-4	C-4	D
Brake rigging	Lye vat	F-2	F-2	F
Buffers	E-2	E-2	E-2	D
Bumper beams	E-2	E-2	E-2	E
Blower connections	Air brake	Air brake	Air brake	E
Cab	C-5	C-5	C-5	D
Cab fittings	Air brake	Air brake	Air brake	F
Cellars	Lye vat	Box	Box	Box
Center Pins	B-1	B-1	B-1	E
Cinder pockets	C-4	C-4	C-4	B and C
Couplers	E-3	E-3	E-3	D
Coupler pocket	E-3	E-3	E-3	D
Crossheads	Lye vat	Piston	Piston	E
Crosshead pins	Lye vat	Piston	Piston	E
Cutting Lever	E-2	E-2	E-2	E
Cylinders	C-4 and B-1	C-4 and B-1	C-4 and B-1	B and C
Cyl. heads—front	E-3	E-3	E-3	E
Cyl. heads—back	Lye vat	E-3	E-3	E
Cyl. head casings	E-3	E-3	E-3	E
Cylinder cocks	Air brake	Air brake	Air brake	F
Cyl. cock rigging	Lye vat	D-1	D-1	F
Canopy	C-5	Boiler	C-5	D
Cylinder jacket	Boiler	Boiler	Boiler	D
Damper valves	Air brake	Air brake	Air brake	E
Deck—Center castings	C-4	C-4	C-4	B and C
Deck sheet—Boards	Boiler	Boiler	D-1	D
Dome covers	C-3	C-3	C-3	B and C
Dome casing	E-2	E-2	E-2	D
Draft appliances	F-4	F-4	F-4	F
Drawbars	C-4	C-4	C-4	D
Drifting valve	Air brake	Air brake	Air brake	F
Driving wheels	C-1	Wheel	Wheel	E
Driving springs	Lye vat	D-5	D-5	D
Driving boxes	Lye vat	Box	Box	Wheel
Dry pipe	C-3	C-3	C-3	B and C
Eccentric cranks	Lye vat	Motion work	Motion work	E
Engine Truck	Lye vat	B-1	B-1 and C-1	E
Equalizers	Lye vat	D-5	D-5	D
Exhaust stand	E-3	E-3	E-3	E
Exhaust nozzle	E-3	E-3	E-3	E
Electrical Conduit	F-6	F-6	F-6	F
Feed water heater	Booster	Booster	Booster	E
Feed water pump	Booster	Booster	Booster	E
Fire Brick	F-5	None	F-5	F
Fire door	Air brake	Air brake	D-2	D
Fire door frame	Air brake	Air brake	D-2	D
Flagstaff	D-1	D-1	D-1	D
Flues	Flue	Flue	B-2	B and C
Flue blowers	Air brake	Air brake	Air brake	F
Flue Bl. Op. levers	E-2	E-2	E-2	F
Frames	C-4	C-4	C-4	B and C
Frame braces	C-4	C-4	C-4	B and C
Frame crossties	C-4	C-4	C-4	B and C
Furnace sheets	Boiler	Boiler	Boiler	B and C
Fire door shields	D-1	D-1	D-1	E
Gage	Air brake	Air brake	Air brake	F



The old jacket storage was inadequate for the shop and many jacket parts had to remain on the floor



The new jacket storage has 49 sections, sufficient to care for all of the locomotives undergoing repair

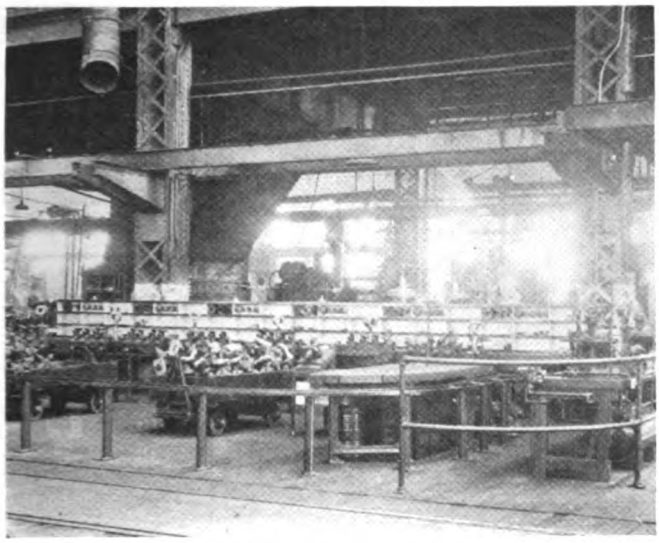
Table II (Continued)

Locomotive part	Delivered to department or section	Repaired in department or section	Stored in department or section	Applied in department or section
Gage lamp	Electrical	Electrical	Electrical	F
Gage cocks	Air brake	Air brake	Air brake	F
Generator	Electrical	Electrical	F-3	F
Grates	F-5	F-5	F-5	F
Grate bearers	D-1	D-1	D-1	D
Grate levers	D-2	D-2	D-2	D
Grate Lev. fulcrum	D-2	D-2	D-2	D
Grate rod	F-5	F-5	F-5	F
Guides	Lye vat	Piston	Piston	E
Guide yokes	C-4	C-4	C-4	B and C
Guide yoke knees	C-4	C-4	C-4	B and C
Gr. Lev. Locks—Guards	D-1	D-1	D-1	E
Hand Railings	E-2	E-2	E-2	E
Headlight	F-3	Jacket	F-3	F
Hub Liners	Wheel	Wheel	Wheel	Wheel
Injectors	Lye vat	Air brake	Air brake	F
Injector levers	Air brake	Air brake	Air brake	F
Jackets	Jacket	Jacket	Jacket	D
Lagging	Lagging	Lagging	Lagging	D
Lubricator	Air brake	Air brake	Air brake	E
Marker lamps	Electrical	Electrical	Electrical	F
Motion work parts	Lye vat	Motion work	Motion work	E
Pedestal binders	Lye vat	C-3	C-2	E
Pilot	E-2	E-2	E-2	E
Piping	Pipe	Pipe	F-6	F
Pistons	Piston	Piston	Piston	E
Piston rod packing	Piston	Piston	Piston	E
Power reverse gear	Air brake	Air brake	Air brake	E
Power rev. bracket	D-1	D-1	D-1	D
Reach rod	Motion work	Motion work	Motion work	E
Reverse levers	Motion work	Motion work	Motion work	D
Reverse shaft	Lye vat	C-4	C-4	D
Rev. counterbalance	D-1	C-4	C-4	D
Rods	Lye vat	Rod	Rod	E
Running boards	E-2	E-2	E-2	D
Small Brackets (Misc.)	D-1	D-1	D-1	D
Safety valves	Air brake	Air brake	Air brake	D
Safety appliances	E-2	E-2	E-2	E
Sand boxes	D-4	D-4	D-4	B and C
Sand traps	Air brake	Air brake	D-4	F
Sander valves	Air brake	Air brake	Air brake	F
Shoes and wedges	Lye vat	C-2	C-2	D
Smokebox braces	E-2	E-2	E-2	E
Spring hangers	Lye vat	D-5	D-5	D
Spring Saddles	Lye vat	D-5	D-5	D
Spring seats	Lye vat	D-5	D-5	D
Stack	D-4	D-4	D-4	B and C
Stack extension	F-4	F-4	F-4	F
Steam pipes	C-3	C-3	C-3	B and C
Steam pipe casings	E-3	E-3	E-3	D
Steam turret	Air brake	Air brake	C-3	D
Steps	E-2	E-2	E-2	E
Stoker Engine	Lye vat	Motion work	D-2	D
Stoker conveyor	Lye vat	D-2	D-2	D
Stoker distributor	Pipe	Pipe	Pipe	D
Superheater flues	Flue	Flue	B-2	B and C
Superheater header	C-3	C-3	C-3	B and C
Superheater units	B-2	B-2	B-2	B and C
Smokebox front	B and C	B and C	B and C	B and C
Smokebox Door	D-4	D-4	D-4	E
St. chest covers—Casings	E-3	E-3	E-3	E
Throttle valve	C-3	C-3	C-3	B and C
Throttle lever	Motion work	Motion work	Motion work	D
Trailer Truck	B-1	B-1 and C-1	B-1	E
Train control parts	Electrical	Electrical	F-3	F
Tires	Machine	Machine	F-7	F-7
Valves	Motion work	Motion work	Motion work	E
Valve gear frame	E-3	E-3	E-3	D
Val. Chamb. Hds.—Casings	E-3	E-3	E-3	E
Waist sheets	C-4	C-4	C-4	B and C
Water glasses	Air brake	Air brake	Air brake	F
Water column	Air brake	Air brake	Air brake	D
Whistle	Air brake	Air brake	Air brake	D
Whistle levers	Air brake	Air brake	Air brake	D

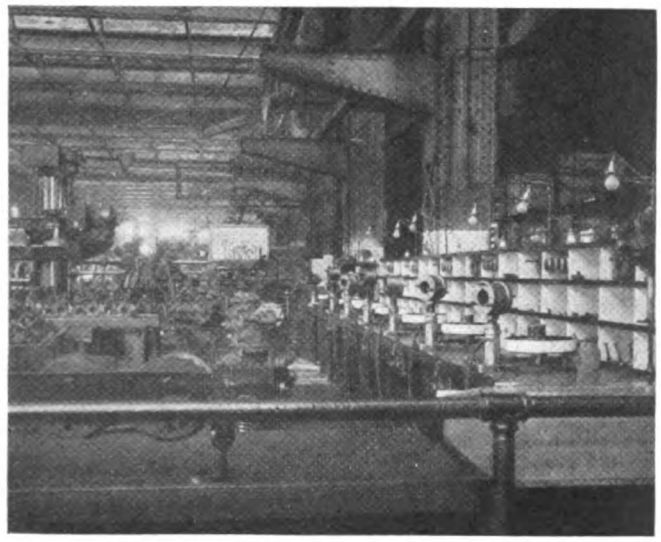
forty-nine sections, which is entirely sufficient to accommodate in each section the complete jacket for each locomotive in the shop undergoing repairs. Similar conditions existed in connection with the storage of locomotive piping. Whereas under the old system piping was stored in some twenty-two locations about the shop, under the new system all of the piping is on racks so de-



Piping which, under the old system, was usually left at some point near the pit, is now repaired and placed in racks



The triple-valve repair department, also on a progressive system, handles the repairs for the entire system



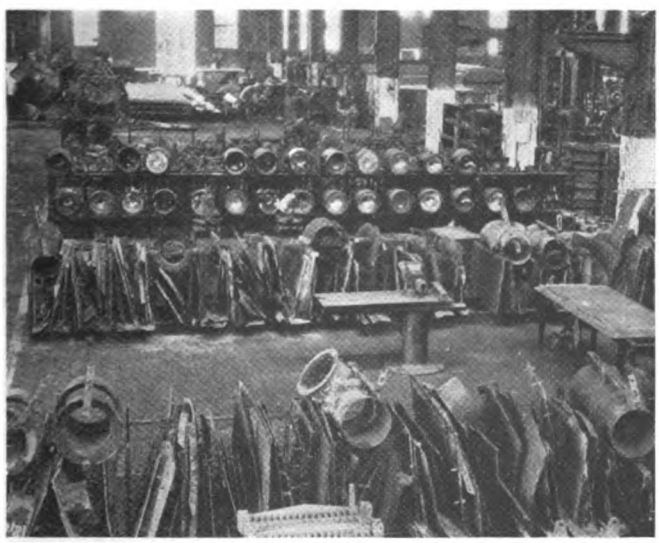
Another view of the triple-valve repair department showing the work bench and many of the special tools

signed that the piping from each individual locomotive in the shop is on a portion of the rack by itself. It is not only possible to see at a glance the condition of the piping, but the systematic method of storing it also lends itself to a more efficient method of repairing piping and, in addition, assures that very little of the piping from a locomotive is ever lost.

Mention is made of the method of storing jackets and piping merely because it is typical of the manner in which the storage of materials and parts all through the shop has been carried out. It will be noticed from the full-page shop layout accompanying this article that these storage locations and departments have been located in such a manner as to facilitate in every way possible the maximum efficiency in repair work.

Movement of Locomotives and Parts

All work pertaining to locomotive repairs in the Sayre shop is now done under one main roof, with the exception of repairs to generators and electrical equipment which are handled in a specialized shop. In conjunction with the installation of the progressive spot system, a materials and parts delivery system was developed to meet the new conditions. By reference to the general layout of the shop and the information given in Tables I and II, it will be possible for the reader to follow with very little difficulty the movement of a locomotive through the shop and to trace the movement of any individual locomotive part as it passes through the shop for repairs and reapplication.



Draft appliances, headlights, generators and bells are repaired and stored in special racks in this section

All locomotives at Sayre are stripped outside the shop on the tracks marked "Section A." The stripping is complete, with the exception of the removal of the driving wheels and engine and trailer trucks. The engine is then run over the turntable and moved inside the shop. Here the locomotive is placed in either Section B or C. Into which of these two sections the locomotive goes depends entirely at this stage of the operation upon the amount of boiler work to be done. Locomotives requiring a comparatively light amount of boiler work are placed in Section C and from there continue in their progressive course around the shop.

Locomotives which require a large amount of boiler work, such as new fireboxes or an unusual number of sheets, if placed in Section C at the outset would merely hold up the progressive movement to successive sections. These locomotives are, therefore, placed in Section B and all locomotives in this section have no particular schedule in relation to the shop as a whole, but the heavy boiler work is performed here and when it has progressed to a state where the locomotive can be placed in the progressive line without holding up the scheduled movement, it is then taken out of Section B and placed in Section C. Other than the boiler work, the work on parts to be repaired in Sections B and C can be seen by reference to Table I.

After the necessary work on locomotives in Section C has been completed, the locomotive is picked up with the overhead crane and moved to Section D. Incidentally, practically all of the movements of the locomotive from one section to the other are made at night so as not to interfere with the normal operations on the day shift. The principal work performed in this section is shown again by reference to Table I.

Section D has been especially equipped for the work of boiler testing and each pit in this section has been fitted with a complete layout of steam and water lines, making it unnecessary to use long hose lines for the testing of boilers.

Upon completion of the work in Section D the locomotive is then moved over into Section E where the

work of reassembling finally begins. The wheeling of a locomotive, for example, is done in Section E. One pit in this section has been especially equipped with blocks and binder jacks which make it possible for a minimum number of workmen to wheel a locomotive with the least possible loss of time Incidentally, many locomotive operations, such as wheeling, which would ordinarily interfere with workmen on the first shift, are performed on the second trick. Pistons, valves, guides, crossheads, rods and motion work are applied in this section.

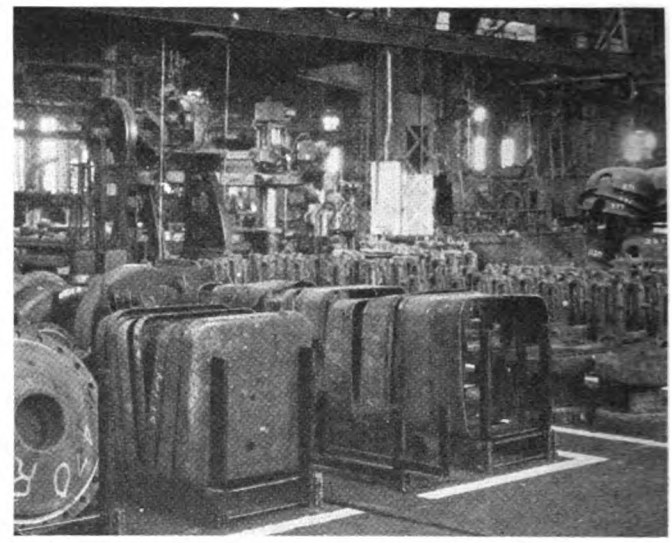
After the locomotive leaves the assembling Section E, it is moved across the shop, turned and lifted over into Section F where the final finishing work is performed. Here such work as the application of cab fittings, train control, electrical work, all pipe work, valve setting and painting, is done. Here also the shop testing is performed and, after this is completed, the locomotive is ready to leave the shop for final testing under steam.

It will be noticed, by reference to the shop layout, that eight pits adjacent to the central shop track and two pits adjacent to Section F near the brake-rigging department are set aside for R-1 and S-1 class locomotives. It so happens that these Lehigh Valley locomotives are of such length that they cannot readily be moved to other sections of the shop.

Departmental Operations

Many of the sub-departments of the shop were completely rearranged and, in many cases, re-equipped coincident with the installation of the progressive spot system. For example, a complete triple-valve department was installed which now does the repair work on all of the triple valves for the Lehigh Valley system. The idea of the progressive system has been carried out in this department on a small scale and it can be seen from the illustrations of this department that the triple valves are moved progressively around a runway on small cars operating on a circular track. They are delivered to this department in special containers by the shop delivery system. They go first to the stripping machines, after which the parts are cleaned and gaged and are then placed in small cars accommodating four valves.

These cars proceed to the repair bench where many special tools have been developed to facilitate the handling and repair of the valves. After the valves are assembled, they are placed by the workmen in the small cars and passed to the test rack. Valves that pass inspection

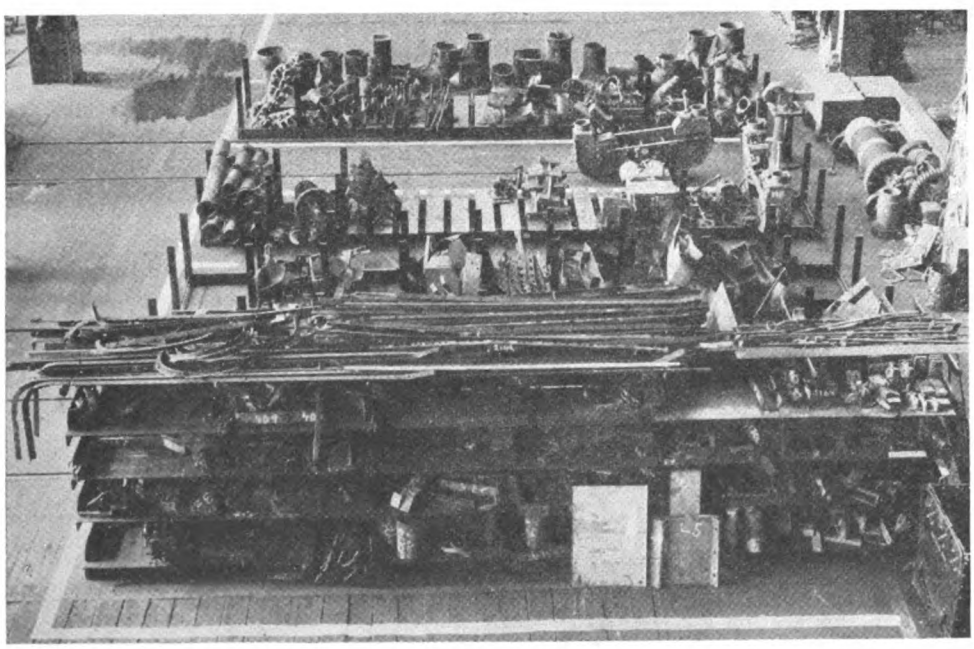


Cylinder heads and casings, steam-chest covers and valve-chamber-head casings have racks for storage

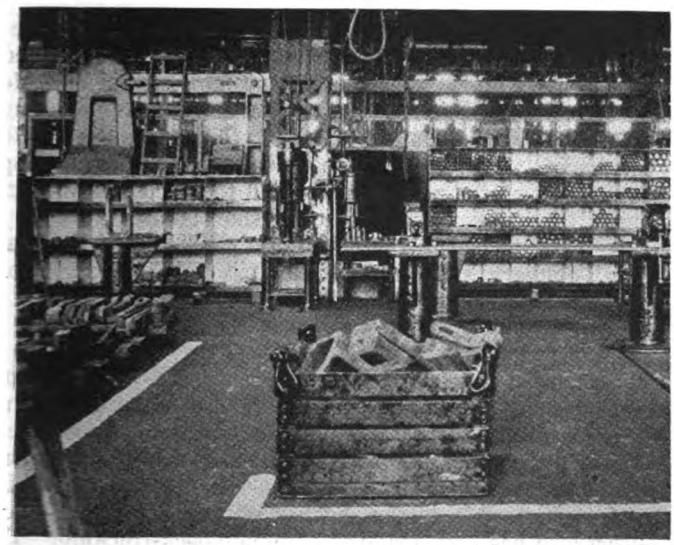
are placed immediately on a bench in a special container in which they are removed for packing preparatory to shipment. Any valves which do not pass inspection are immediately replaced in one of the small cars on the circular track and go round again to the man who originally assembled them.

One of the most noticeable improvements in the shop was made in the brake-rigging department where considerable difficulty was experienced under the old system in keeping the work up to date. Under the new method the brake rigging after having been removed from the locomotive and cleaned is taken directly to the blacksmith shop, from which it is delivered to the machine shop for necessary repairs. It is then taken to the brake-rigging department and placed in storage racks and classified. In assembling brake rigging it is placed on a movable platform which, when loaded, is moved to the locomotive in the finishing section by overhead crane.

Under the old system of repairing a locomotive many small brackets when removed from locomotives were either destroyed or lost. This not only caused considerable expense, but it was found that the location of the appliances which were secured by the brackets usually



Miscellaneous brackets are carefully stored to prevent loss



The spring-rigging department showing container for parts

was changed when a new bracket was made and it was then necessary to re-form all of the pipes connecting the appliances. Under the present system storage racks for these miscellaneous small brackets are provided and, by conserving the original brackets, the volume of pipe work has been considerably reduced.

The work of repairing superheater units was formerly performed in the blacksmith shop which was over one thousand feet from the nearest pit in the locomotive shop, making it necessary to transport units between the erecting shop and the blacksmith shop by truck. The new superheater-unit repair shop has been installed in Section B-2 of the erecting shop and it served entirely by overhead cranes. This has resulted in the saving of considerable time formerly lost in transporting units and has materially speeded up the work of their repair.

Shop Delivery System

Under the jurisdiction of the stores department a material delivery system has been developed at Sayre which, in conjunction with the progressive spot system, has resulted in a great saving in time in the handling of parts and materials. The delivery trains moving over designated routes are dispatched from a central point and on regular schedules. No special trips are made. The delivery system not only serves the main locomotive repair shop, but also serves the passenger-car repair department and the enginehouse.

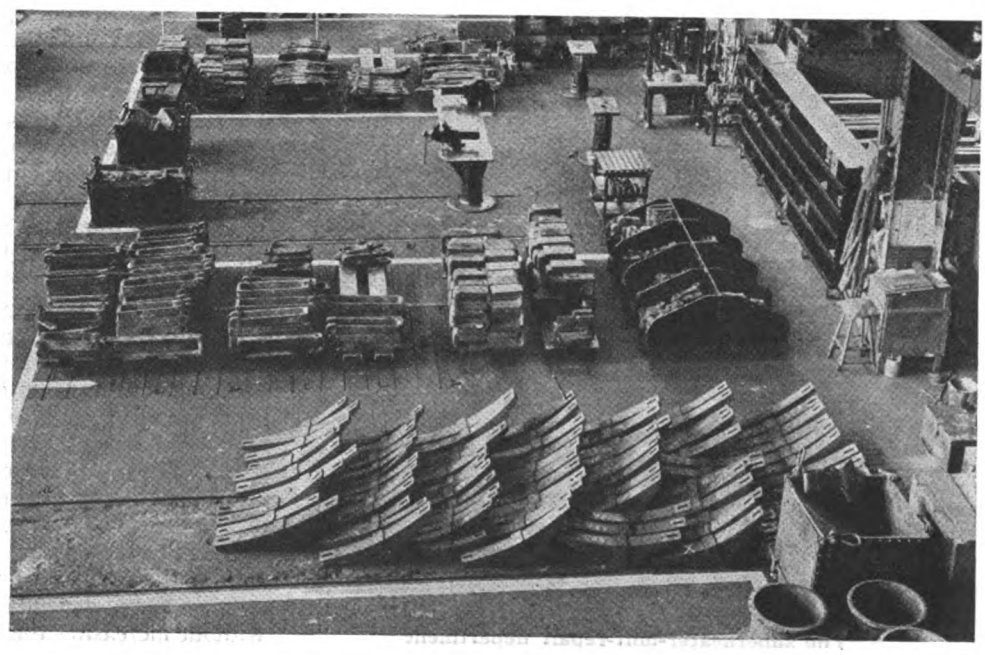
As far as the locomotive work is concerned, the delivery trains move over two general routes, the courses of which are designated by the lines with arrowheads on the shop layout drawing. At fixed locations on these routes are permanent delivery and pick-up stations which are designated by station numbers in circles on the shop layout drawing.

Over route No. 1 tractors with trailers leave the storehouse every hour, beginning at 8 a.m., passing through the blacksmith shop, the east erecting bay, returning through the east machine bay and the blacksmith shop to the storehouse. On each alternate trip the station order is reversed to take care of the movement of material going in opposite directions.

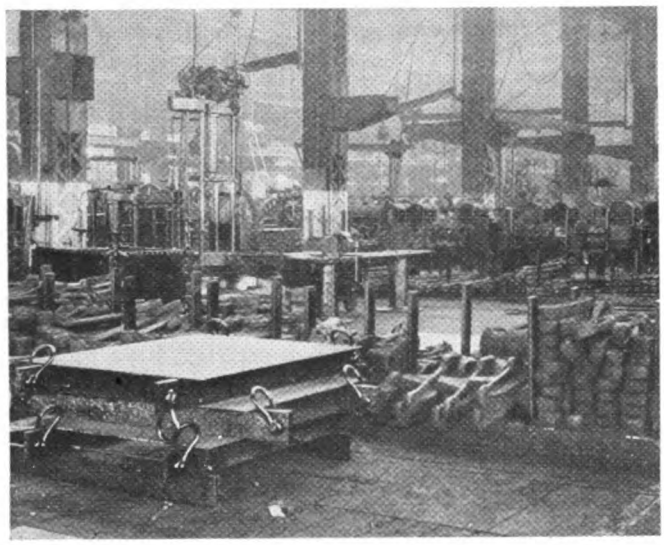
Over route No. 2 tractors with trailers leave the storehouse every hour, beginning at 8 a.m., passing through the blacksmith shop and the west erecting bay, but return through the west machine bay and the blacksmith shop to the storehouse. On this route, as on route 1, on each alternate trip the station order is reversed to take care of the material going in opposite directions. Outside of the main locomotive shop delivery route 2 also goes in the course of its travels to the electric shop and the enginehouse.

These routes are manned by a tractor operator and laborer who handle the movement of all new materials from the stores department to the shops and the movement of all materials and parts between various departments of the shops in the territory covered. The routes are so laid out that they pass all salient points where loads accumulate and deliveries are made.

While there are delivery stations throughout the plants established by the mechanical department, the operators do not arbitrarily make deliveries to these stations, but endeavor to deliver all heavy or bulky material that would require considerable labor in rehandling as near as possible to the point where it is to be used. For instance, rough shoe and wedge castings, crown brasses and driving-box castings, large quantities of rough bolts, etc., are delivered direct to the machines where they are finished. Such items as grates, arch bricks, springs and boiler lagging are delivered direct to the erecting shop pits. The number of trailers carried on each trip varies



The department where the spring rigging is repaired



Brake rigging is handled in sets on special platforms

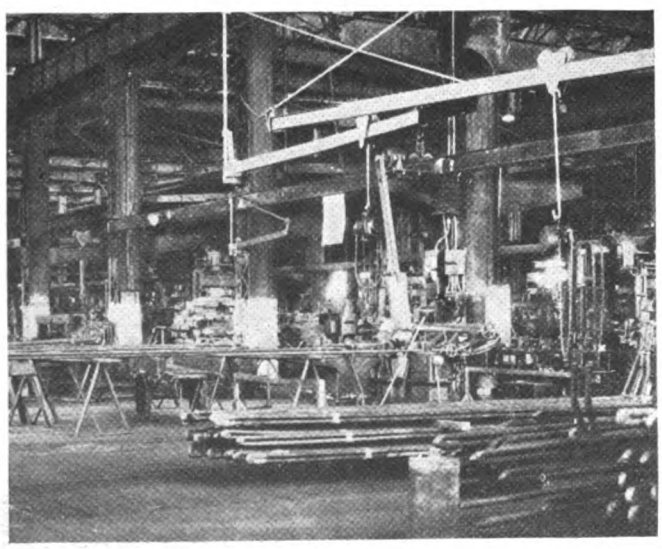
from two to six, depending on the volume of business.

No verbal orders are accepted for transportation service via the delivery system. The delivery of new material is covered by a carbon copy of the material order, which shows the material required and the delivery point. Inter-dependent and inter-shop movements are covered by an inter-shop transportation order. Material and transportation orders are deposited in station boxes by shop foremen and are picked up by tractor operators as they pass along the routes.

New materials orders are brought to the storehouse on the return trip where they are stamped with a time stamp and turned over to the man in charge of loading trailers to be loaded for delivery on the next trip. Any shop transportation orders are examined by the operators and the movement specified is handled on the same trip on which the order is picked up. These orders are then checked as completed by the operators and turned in to the transportation foreman's office on each return trip, where they are time stamped and placed on file.

In addition to the transportation of materials and supplies new applications of the material handling equipment are continually being found. As an example of an operation which is saving considerable money as well as providing a worthwhile service for the mechanical department is the collection and disposal of ashes, refuse and small scrap which accumulates in and around the repair pits in the locomotive shop. These pits are cleaned once a week and, under the new system, a train is made up of a tractor, three 1½-yd. capacity gravity dump trailers and two standard material trailers equipped with box bodies. This train passes down through the erecting bays, back of the erecting pits, and the accumulation removed from the pits is loaded by shop laborers.

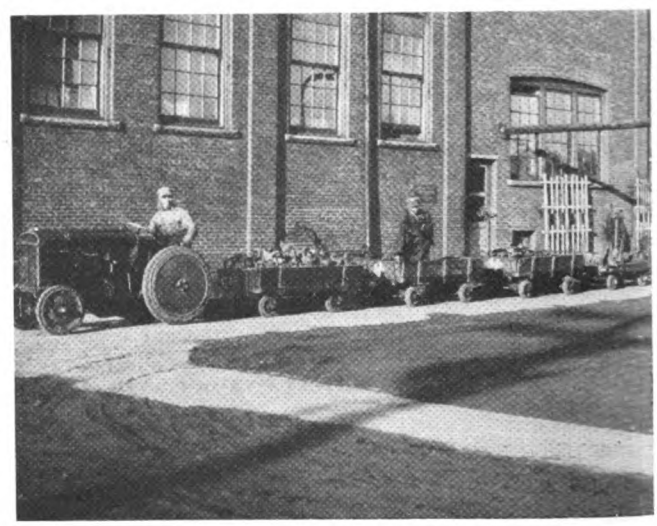
In order to assure the maximum efficiency of the material delivery system approximately 20,000 sq. ft. of concrete roadways of 8-ft. width were laid.



The superheater-unit-repair department

Conclusion

The application of the progressive spot system of locomotive repairs in the Sayre shop has resulted in the concentration of specialized work at a number of fixed points throughout the shop in such a manner that the movement of materials and parts has been confined, in so far as possible, to the shortest possible distances. An effort also has been made to eliminate back-tracking. To the outside observer one condition is especially noticeable—the relative absence of workmen and supervisors moving about the shop. The progressive spot system has to a great extent eliminated the necessity for doing this because of the fact that not only the locomotives, but also the materials and parts, come to the workmen—it is rarely necessary for them to leave the department in which they are employed.



Material-delivery train leaving the storehouse

The principle of "a place for everything and everything in its place" has been carried out to the highest degree and the result is that even in such small departments as sub-toolrooms the workmen who are responsible for conditions in those departments have become imbued with the idea that an orderly shop is the shortest cut to the way in which to perform a given job with the least effort. Having eliminated a great part of the lost motion within the shops, the entire efforts of the workmen can be devoted to the problem of improving the quality of workmanship on each job performed. Better workmanship and more thorough inspection in the shop brought about as a result of this system are becoming noticeable in the better performance of locomotives on the road. The objective of the management in locomotive repair work is to turn out a locomotive in such a manner that it can perform road service with a minimum of delays due to mechanical causes. The object of this radical step in the method of repairing locomotives has been to assure more dependable service from motive power without increasing the cost of maintenance.

How to Stimulate and Cultivate Goodwill of the Public*

Public Relations Officer tells Editor how mechanical department officers and employees can help build up goodwill and intelligent interest on part of public

FOR many years the railroads have had to operate under close supervision by municipal, state and federal regulating authorities. Unfortunately, in many instances they have become the football of the politicians. For some reason, hard to comprehend, the general public also seems to believe that the railroads have unlimited resources. As a result, it has been necessary for the railroads, for their own protection and to avoid disaster, to carry on educational campaigns to remove these misunderstandings and improve relationships. Gradually, formal public relations departments have been established on many railroads with a view to organizing and promoting such educational programs.

Public Relations Work Defined

Is it possible for mechanical department officers and employees to be helpful in improving relations between the railroads and the public and, if so, exactly how can they co-operate to the best advantage?

This question was propounded by the Editor to a Public Relations Department Officer who has been unusually successful in stimulating the employees to cultivate goodwill in the territory which his road serves.

"Might it not be well," replied the Public Relations Officer, "before going into details, to agree upon a definition of public relations work? Let me also emphasize the fact that while you speak of me as a public relations officer, we have no formal department of that sort, since our activities are integrated with the entire organization. In defining public relations work the approach usually made is in terms of influencing legislation and regulation, of political conflict, of the economics of railway operation, and of traffic solicitation. Of course, these are part of the task, but they are not the whole task, and I doubt if they give a clear picture of it. I wonder if it is not better to deal with it in terms of interpreting the railroad to the thousands of people who live in the communities which it serves, and whose lives are affected in so many ways by the service it performs. With such a definition it will be plain that the public relations work is the job of every man on the railroad."

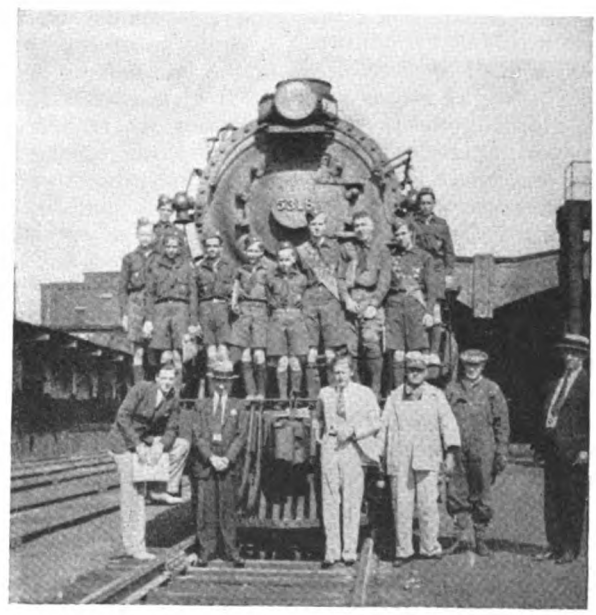
"I like your definition," I said, "for it presents a responsibility and an opportunity that includes every employee in the mechanical, as well as all other departments. With this as a background, what is your next suggestion?"

"You have no idea," said he, "how large a proportion of the public is interested in railroad equipment and its operation. We are constantly surprised at the number of 'fans' who have no active relation with the railroads, and yet who follow the equipment improvements, and particularly those on locomotives, with keen interest. Then, too, there are a large number of model makers who use their leisure time in constructing models of cars and locomotives in an attempt to reproduce, in exterior appearance at least, well-known types of locomotives on different railroads. These, however, are only surface indications of an eager interest in such developments on the part of the general public at large."

An editor, of course, has constant reminders of these things in his correspondence and in other contacts with the public. I was rather inclined, however, to question whether the interest was quite as keen and extensive as the Public Relations Officer indicated, and suggested that possibly he had overstated the facts.

New Equipment Attracts Attention

"Let us consider a few specific illustrations in support of my statement," replied the Public Relations Officer. "Take, for instance, the two new, high-speed, streamlined trains that have recently been built for the Union Pacific and the Chicago, Burlington & Quincy. Crowds have flocked to see these trains wherever they have been placed on exhibition and other thousands have lined the right-of-way when they knew the approximate time at which the trains would pass. It was not unusual to see large groups of school children, who had been excused to go in a body to view the trains as they passed through communities. The Travel and Transport Building at the Century of Progress Exposition at Chicago is among the most popular of the exhibits, and thousands of people pass through the passenger trains and locomotives located in the track exhibit outside the building. By actual count, the number of people who passed through the Union Pacific train on



Boy Scout troop of Paterson, N. J., visits B. & O. terminals in Jersey City

* Thirteenth of a series of interviews with men outside the mechanical department, commenting in a constructive way upon the possibilities of that department.

its tour through the country and at the Century of Progress Exposition is well over a million and a half.

"Transportation always has had a fascination for the average citizen," continued the Public Relations Officer. "The Wings of a Century pageant at the Chicago exposition, which graphically portrays the improvement that has been made in transportation since the early days in this country, is regarded by many as the most interesting and instructive exhibit on the grounds. If you will think back a few years to the Baltimore & Ohio centenary exhibit at Halethorpe, you may recall that it proved a much greater drawing card than the railroad management thought it would be, and had to be continued longer than was anticipated."

"These are rather spectacular developments," I suggested. "I am wondering what the mechanical men can do in the average community that may serve to interest the public and cultivate a more friendly attitude toward the railroad."

Cultivate Showmanship

"While these illustrations are exceptional," replied the Public Relations Officer, "you will find that, if properly promoted and sponsored, the average community will be very much interested in any new development in the locomotive or car equipment, or even in the normal operations of an enginehouse or repair plant. What is needed by railroad managements is an appreciation of showmanship. There is not the slightest doubt in my mind but what people in any community will take advantage in large numbers of an invitation to visit the station or the shops to examine new locomotives or new car equipment, either freight or passenger. The trouble is that the mechanical department people do not appreciate how such things appeal to the general public, and so they do not take the initiative in playing them up.

"In several instances," continued the Public Relations Officer, "the local mechanical department officials have arranged to have groups of school children, Boy Scouts, or the general public make inspection visits to their locomotive and car repair shops. You may say that this is a matter of inconvenience and expense, because it upsets the shop routine and requires the services of employees as guides. If you have no appreciation of what this means in cultivating an interest in the railroad and its problems, then I suppose that from a dollars and cents standpoint it may be regarded as a wasteful expenditure. But I cannot agree with so limited a point of view.

"In the first place," he continued, "such gestures will bring the public in touch with railroad officers on a friendly basis, and will present opportunities for educating the public as to some of the problems of the railroads. In some instances it may mean that young people who have never traveled on a railroad (and there are many such) will become so interested that they will be intrigued into giving it a trial. Surely, no traveler who has gone through an air-conditioned train, even when standing still in the shop or at the station, or on exhibition at some other place, will fail to appreciate the advantages of this type of equipment.

"Let me give you another concrete illustration," said the Public Relations Officer. "One of the cities on our line celebrated an important anniversary. We were asked to place on exhibition in the public square a reproduction of one of the early locomotives which had served this section of the country. This we gladly did, but we also exhibited on a side track, not far away, one of our latest types of locomotives, which today serves this same district. Naturally the public was impressed; many of the people looked the modern locomotive over carefully, climbing into the cab and examining and asking questions about the different gadgets."

Talking to the Public

"Do your mechanical department people have any opportunities of speaking to the public?"

"Yes," replied the Public Relations Officer, "and some of them are doing fine work. Our mechanical department employees should avail themselves of every opportunity to speak before Chambers of Commerce, service clubs, Boy Scouts, schools, or any other group to which they may be invited. If I were to make any criticism of these talks, I would say that in too many instances the speakers are over-ambitious, the danger being that they will shoot over the heads of the people. The man who can make a simple, plain talk about that part of railroading in which he is specially engaged, may register much better results than one who attempts to give a scholarly discussion of some of the larger railroad problems.

"The people in a local community, for instance," he continued, "will be specially interested in data as to that part of the payroll which comes to their community, with a break-down as to how it is expended for various purposes. Many of the communities in which large shops or car repair points or engine terminals are located, depend to a very large extent on the money expended by railroad employees. It is well to remind them of this and in such simple terms that its import can readily be grasped. There are also splendid opportunities for getting over the extent to which the railroads are taxed, or the way in which they are discriminated against by subsidized types of carriers who do not have to conform to the rigid regulations which control the railroads."

Railroads Need Boosters

"Is it possible for the mechanical department employees to assist in securing traffic?" I asked.

"In many instances, yes," replied the Public Relations Officer. "We have concrete illustrations of this in the splendid accomplishments of booster clubs on many railroads, just as we know that favorable opinion has been created for the railroads in many places by the formation of railroad employees' and taxpayers' associations. Mechanical department employees, if they will join with other members of the railroad family, can by their very numbers make a strong impression upon the community, and this should be reflected in a more tolerant and friendly spirit—and in more consideration on the part of the law making and regulating authorities."

"It appears that the employees of the mechanical department can render even larger services than I anticipated," I suggested. "They have much the same possibilities of using their influence as employees of other departments, but as you have so clearly pointed out, there are also special ways in which they can be of service."

"Quite right," replied the officer. "I have no doubt, also, but that the opportunities for public relations work can be more fully developed. Many people fail to do things that they could do, because they are not spectacular. Addressing a public meeting is a spectacular thing, but it is often possible to exert a wider influence through the less spectacular method of simply talking with one's friends. There are a million railway employees in the country and if every one of them would undertake to 'sell' the railroads to a score of people, there would be no problem of adverse legislation and restrictive regulation. The fact that the public is interested in the development of cars and locomotives opens up innumerable opportunities for effective public relations work by officers and employees of the mechanical department."

Roller Bearings for Main and Side Rods on D. & H. Locomotives

By B. W. Taylor*

S K F bearings for rods and main driving boxes have been operated satisfactorily in over 25,000 miles of heavy passenger service

AN article describing roller-bearing journal applications for the engine truck, drivers and tender trucks of a Hudson type locomotive on the New York Central, with some observations on performance after 130,000 miles in high-speed passenger service, also a brief resume of the development of anti-friction bearings for locomotives generally, appeared in the *Railway Mechanical Engineer,* November, 1932, page 451. Satisfactory results on this and a considerable number of other locomotives justified experiments in the use of such bearings on main rods and side rods in an effort to improve still further the mechanical design of locomotives.

On February 2, 1934, the Delaware & Hudson placed in service locomotive No. 609, 4-6-2 type, equipped with S K F anti-friction bearings on the back ends of the main rods and the main sections of the side rods. Bearings of the same type were also applied on the main driving axle boxes.

This engine is used in high-speed passenger service, handling express and limited trains between Albany, N. Y., and Montreal, P. Q., as well as some local movements. The mileage to June 1, 1934, was approximately 25,000, of which 9,052 miles were made during the month of May.

This locomotive is the first to be equipped by any road in America with anti-friction bearings on the rods and placed in regular revenue service and, so far as the author can learn, it is the first in the world for any engine of comparable size and speed. Within the last two months another Pacific type engine of about the same size has been equipped with anti-friction rod bearings and placed in service on one of the large Eastern systems.

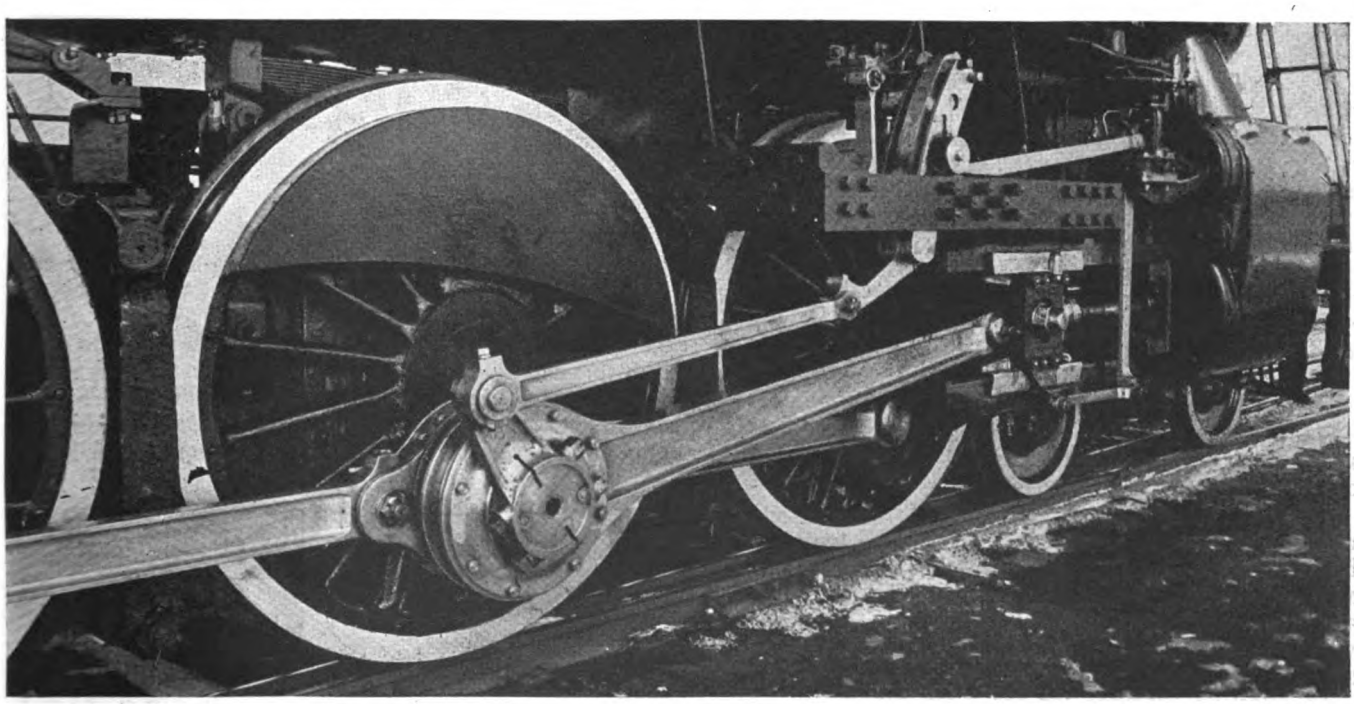
Locomotive 609 exerts a tractive force of 42,750 lb., with cylinders 24 in. by 28 in. and driving wheels 73 in. in diameter. The boiler operates at a pressure of 225 lb. The total weight of the engine is 295,000 lb., of which 192,500 lb. is carried on the driving wheels. Other principal dimensions and weights are shown in the table.

The locomotive was originally built by the American Locomotive Company in 1914, and an opportunity for applying anti-friction bearings was afforded by the rebuilding of the engine at the railroad company's Colonie (N. Y.) shops. The Delaware & Hudson, the American Locomotive Company and the S K F Industries, Inc., jointly carried out this work, the builder supplying the main driving-axle assembly complete with wheels, bearings, boxes and rods to the road for installation. This involved a considerable amount of design work by the builder on rods and pins to get proper counter-balancing with anti-friction bearings.

The Bearing Application

The same size bearing is used both for the back end of the main rod and the main section of the side rods, the bearing for the former having a tapered bore and tapered sleeve to secure the inner race to the crank pin and the

*Railway engineer, S K F Industries, Inc., Philadelphia, Pa.



S K F roller bearings are applied to main and side rods at main pin connection on D. & H. locomotive No. 609

latter a straight bore with press fit mounting. This arrangement lends itself to the proportioning of the pin for strength in bending and in a large degree at least to convenience in mounting and dismounting rods. Bearing dimensions are as follows: Outside diameter, 16.5364 in.; width, 5.4330 in.; bore for the side-rod bearing, 8.6614 in., and for the tapered sleeve used with the main rod bearing, 7.8740 in. This gives approximate crank-pin diameters of $8\frac{11}{16}$ in. and $7\frac{7}{8}$ in., at the side-rod and main-rod locations, respectively. The maximum piston thrust is 102,000 lb., approximately; cylinder centers, 91 in., and frame centers, 41 in.

The bearings are of the S K F spherical self-alining type, with two rows of rollers, a spherical outer race, and positive guiding on the inner race. All parts of the bearing, except the two retainers, are of carbon-chromium steel hardened throughout, ground and polished. The retainers are made of bronze and serve to space the rollers properly. Their weight is carried on the raised central section of the inner race known as the "inner-race land." This is essential for any bearing operating on a crank pin, otherwise the effect of centrifugal force would be to wedge the rollers in the retainer pockets, thereby producing lubrication difficulties and high stresses in the retainers. The bearing is a self-contained, non-adjustable unit, a thrust and radial load carrier, and within the limits of clearance between the sides of the rod ends affords flexibility and alinement for the rods with respect to the main driving axle, for any position which the latter may take with respect to the frame. Such flexibility goes far to eliminate many of the troubles experienced with several types of rod bearings now in use. Stability for the rods at the other ends is obtained from the friction bearings on the crosshead pin, and from the crank pin on the front driver.

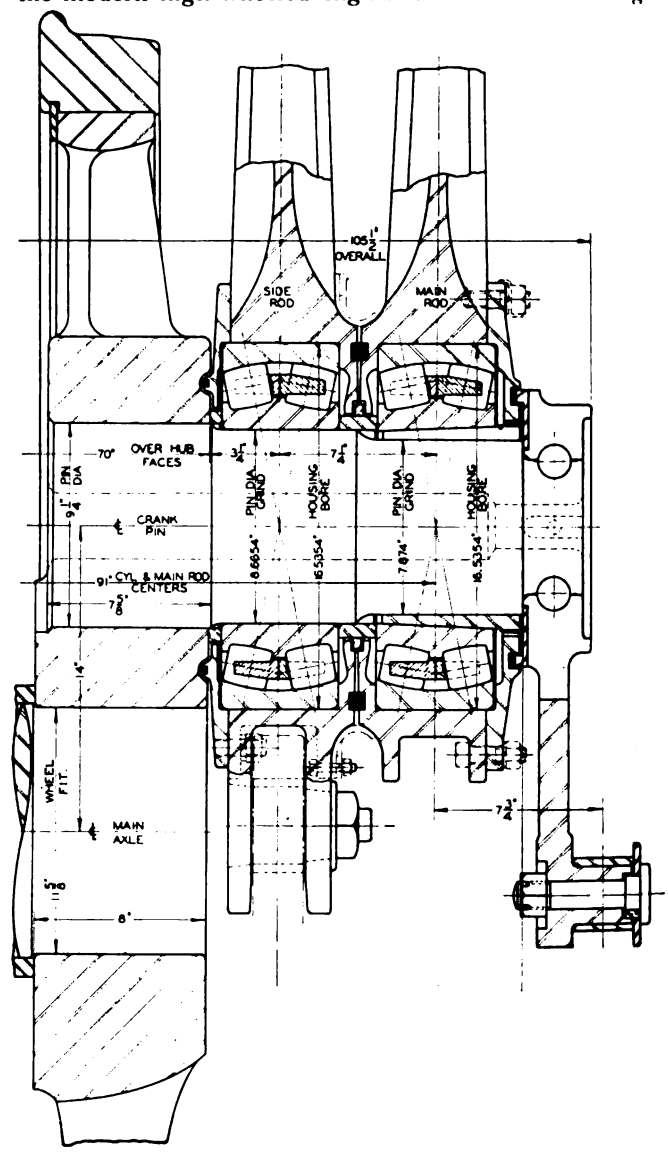
In mounting the bearings on the pins the basic principle is to remove practically all radial looseness from the assembly. This is done by expanding the inner races in mounting and making the outer races tight fits in the rod ends. Before mounting, the radial looseness in the bearings is 0.0035 in. to 0.0045 in. The inside bearing is heated in oil and shrunk on the pin and the outer one secured by driving up the tapered sleeve (taper 1 in 12) to secure rigidly the inner race to the pin, at the same time measuring the expansion of the inner race with thickness gages inserted between the rollers and the outer race. A threaded extension on the tapered sleeve is provided to take a wing nut which will withdraw the sleeve when the main rod has to be dismounted. The outer race in the main rod is mounted with a press fit approximately 0.0015 in. tight, but the fit in the side-rod end is lighter since this rod must be mounted with the bearing on the pin. The tapered sleeve is locked by axial pressure from the eccentric crank exerted against a steel plate (which also serves to close the split in the eccentric crank) and a shim. The eccentric crank itself and its location are in accordance with common practice.

The crank pin and the rods are of nickel alloy steel, heat-treated, and a considerable saving in weight of these parts has been effected by careful design of the rod sections. The pin is hollow bored and ground on the outside diameter for the bearing fits.

It is of particular interest to note the difference in weight on the main driving axle at the rail with friction bearings and with anti-friction bearings. Scale weights are not available, but calculations indicate that there is an increase of 2,300 lb. with anti-friction bearings, of which 900 lb. is chargeable to the rod-bearing applications and 1,400 lb. to the driving boxes and bearings.

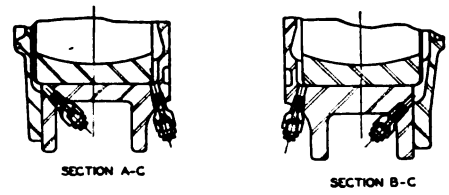
In selecting bearings for the main pin it was necessary to consider bearing capacity in relation to the space available for bearings. The required bearing capacity for adequate life is obtained from calculations based on piston thrust and the inertia effect of the reciprocating parts. The space available for bearings is either influenced or directly fixed by the following: Driving-wheel diameter, pin size, weight for counterbalancing, distance between frame centers and distance between cylinder centers.

The effect of wheel diameter is not great, and with the modern high-wheeled engine it is not difficult to get



Section through crank pin showing detailed construction of roller bearing application to main and side rods

the necessary clearance over the top of the rail. In general, this can be obtained with a minimum driving wheel diameter of 66 in. (new tires). With alloy steels now available crank-pin diameters can be reduced a sufficient amount to accommodate the design without jeopardizing



Section A-C through side rod and section B-C through main rod showing grease fittings

the strength of the pin. This also applies to the rods used, particularly to the sections of the rod ends. The figures given on the weights of the parts for counterbalancing give some idea of the possibilities here, which, in the development of this particular design, were something of a surprise. The distance between cylinder centers is of primary importance. It definitely and finally fixes the length of the pin to the center line of the main rod, hence, the width of the bearings and the space available for grease and grease seals. This dimension usually varies between 89 in. and 93 in. for different locomotives. In this case, it is 91 in.

Counterbalancing

The table giving weights of parts for counterbalancing shows how this problem was solved by the American Locomotive Company and the railroad. The figures are approximate, as some are actual and others estimated weights, but they fairly represent the conditions. As originally built the locomotive was counterbalanced for all of the revolving weights and approximately 62.7 per cent of the reciprocating weights*, but when the engine was rebuilt and anti-friction bearings applied, it was cross-balanced. This must be taken into account in comparing the two conditions and allowance also must be made for the fact that changes from the original design had increased the weight of the reciprocating parts.

Comparison of Counterbalances for Change in Reciprocating Parts—Re-Built Engine

Net reciprocating balance	Anti-friction bearings	Friction bearings
Actual	$\frac{762}{1860}$ = 40.9 per cent	$\frac{1109}{1765}$ = 62.7 per cent
Comparison based on Original engine	$\frac{762}{1692}$ = 45.2 per cent	$\frac{1109}{1765}$ = 62.7 per cent
Comparison based on Re-built engine	$\frac{762}{1860}$ = 40.9 per cent	$\frac{1109}{1933}$ = 57.5 per cent

Counterbalance Weight Table—Main Drivers

	Anti-friction bearings	Friction bearings
Weight side rod on front pin	123 lb.	135 lb.
Weight side rod on back pin	125 lb.	148 lb.
Weight side rod on back pin (incl. roller bearing and all parts) (A)	670 lb.	472 lb.
Weight back end main rod (incl. roller bearings and all parts) (B)	649 lb.	520 lb.
Weight eccentric crank equivalent (C)	80 lb.	66 lb.*
Weight cross-balance, revolving parts (D)	294 lb.	0 lb.
A + B + C + D	1,693 lb.	1,058 lb.
Weight on main pin to balance block	1,953 lb.	1,500 lb.
Reciprocating weight main wheel	260 lb.	442 lb.
Weight on front or back pin to balance block	375 lb.	475 lb. 475 lb.
Avg. revolving weight front or back pin	124 lb.	135 lb. 148 lb.
Reciprocating weight front or back pin	251 lb.	340 lb. 327 lb.
Total, front and back pins	502 lb.	667 lb.
Same—main wheel	260 lb.	442 lb.
Total reciprocating weight per side	762 lb.	1,109 lb.
Reciprocating weights:		
Front end—main rod	290 lb.	363 lb.†
Crosshead	806 lb.	719 lb.
Piston and rod	735 lb.	660 lb.
Union link	29 lb.	23 lb.‡
Total	1,860 lb.	1,765 lb.
Net reciprocating	762 lb. = 40.9 per cent	1,109 lb. = 62.7 per cent
Balance	1,860 lb.	1,765 lb.

* New and heavier crank for rebuilt engine.
† Alloy steel rod lighter for roller bearings.
‡ Changed other parts for rebuilt engine.

These are noted in the remarks column in the table and the table of comparison of counterbalances further illustrates this. The principal purpose of the data given is to show that the counterbalancing problem can be satisfactorily solved when anti-friction bearings are used.

The dynamic augment at diameter speed is given by the following expression:

$$D = W \times 3.2 \times \frac{S}{2}$$

where D = dynamic augment, lb.
W = overbalance, lb.
S = stroke in inches

For the locomotive with friction bearings

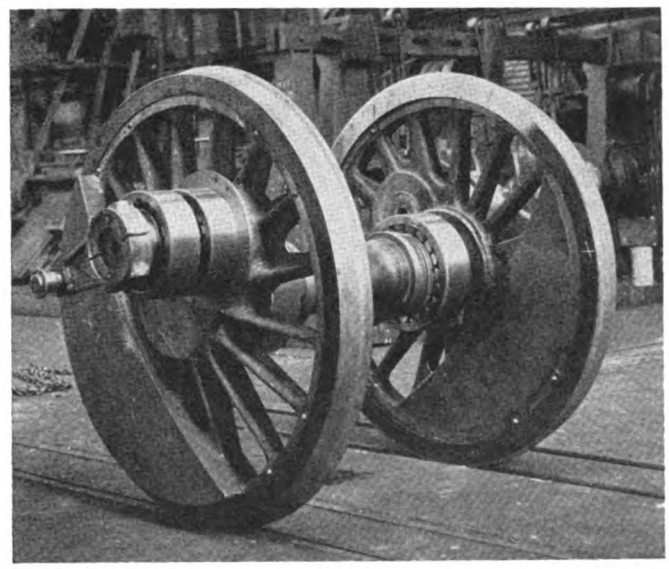
$$D = (1{,}500—1{,}058) \times 3.2 \times \frac{28}{2}$$
$$= 19{,}800 \text{ lb.}$$

and cross-balanced with anti-friction bearings

$$D = (1{,}953—1{,}693) \times 3.2 \times \frac{28}{2}$$
$$= 11{,}640 \text{ lb.}$$

Method of Lubrication

The lubricant used is grease, introduced into the bearings by an Alemite gun of 13 oz. capacity. One of the accompanying sectional drawings shows the fittings, two per rod end, and so arranged as to supply independently grease to each side of each bearing. This is to afford the lubricant as much opportunity as possible to get into the bearings and lubricate the inner-race guide rails in contact with the roller ends, as well as the cage contact on the inner-race land. The grease capacity of each rod end is 52 oz. approximately.



Main driving-wheel and axle assembly with roller bearings for main and side rods and for driving boxes

A great deal of attention has been given to the service requirements for lubrication, as this is an important factor in operation. Tests have shown that the locomotive can be safely operated 500 miles in through service without the addition of any grease, but the present practice is to add approximately one-half a gun full to each of the main rods and about a gun full to each of the side

* See report of Committee on Locomotive Design and Construction, A.R.A. Mechanical Division, 1930, for methods of counterbalancing. An abstract of this report was given in the *Railway Mechanical Engineer*, August, 1930, page 448.

rods per trip of 240 miles. There is an inspection hole on the front cover of the main rod, but none on the side rod, and there seems to be more loss of grease at the seal nearest the wheel hub than from the others, hence the greater quantity added to the side-rod bearings. The grease that is lost is thrown out from the rod ends due to the action of centrifugal force, the small space available, and the pressure produced by the rolling elements in the bearings. Further experiments are being made to determine the minimum grease required, maximum safe mileage between greasings and to improve all of the seals by the use of more effective packing. The labyrinth clearances must be ⅛ in. approximately on the radius, to allow the rods to aline relative to each other and to the pin. New seals will be ready for application at the first convenient shopping of the locomotive.

The first grease used was very light in consistency, having about 14 per cent soda-lime soap, in order to get the maximum flow of grease into the bearings and between the two rows of rollers. This was followed by a heavier grease with 19 per cent soap content. The latter is of about the so-called No. 2 consistency and is used at present. Both greases provided satisfactory lubrication, but the heavier grease is somewhat easier to retain in the rod ends. Tests are contemplated with a still heavier grease, but one which would still be much lighter than the ordinary rod grease for friction bearings.

Table of Dimensions, Weights and Proportions of Delaware & Hudson Locomotive No. 609 Equipped with S K F Bearings

Railroad	Delaware & Hudson
Builder	American Locomotive Co.
Type of Locomotive	4-6-2
Service	Passenger
Cylinders, diameter and stroke	24 in. by 28 in.
Valve gear, type	Walschaert
Valves, piston type:	
Maximum travel	6½ in.
Steam lap	1⅛ in.
Exhaust clearance	3/16 in.
Lead Full Gear	Front 0, Back 9/16 in.
Cut-off in full gear, per cent	85
Weights in working order:	
On drivers	192,500 lb.
On front truck	47,500 lb.
On trailing truck	55,000 lb.
Total engine	295,000 lb.
Tender, loaded (⅓ load, coal and water)	160,500 lb.
Total engine and tender	455,500 lb.
Wheel bases:	
Driving	13 ft. 0 in.
Total engine	34 ft. 10 in.
Total engine and tender	76 ft. 8 in.
Wheels, diameter outside tires:	
Driving	73 in.
Front truck	33 in.
Trailing truck	45 in.
Journals, diameter and length:	
Driving, main SKF roller bearings	11 in. by 13 in. nominal
Driving, others	11 in. by 13 in.
Front truck	6½ in. by 12 in.
Trailing truck	8½ in. by 16 in.
Boiler:	
Type	Radial stay, straight top
Steam pressure	225 lb.
Fuel	Bituminous coal
Diameter, first ring, inside	76 9/16 in.
Firebox, length and width	132⅛ in. by 108¼ in.
Height bottom of firebox ring to crown sheet, front	84 in.
Height bottom of firebox ring to crown sheet, back	63½ in.
Arch tubes, number	5
Combustion chamber	None
Tubes, number and outside diameter	252-2 in.
Flues, number and diameter	34-5-½ in.
Length over tube sheets	20 ft. 0 in.
Grate area	99.32 sq. ft.
Heating surfaces:	
Firebox	277 sq. ft.
Arch tubes	40 sq. ft.
Tubes and flues	3579 sq. ft.
Total evaporative	3896 sq. ft.
Superheating	840 sq. ft.
Comb. evaporative and superheating	4736 sq. ft.
Tender:	
Style	Rectangular, water-bottom
Water capacity	11,000 gal.
Fuel capacity	14 tons
Journals, diameter and length	6½ in. by 12 in.
General data estimated:	
Rated tractive force	42,750 lb.
Weight proportions:	
Weight on drivers ÷ total weight, engine, per cent	65.2
Weight on drivers ÷ tractive force	4.50
Total weight engine ÷ comb. heat. surface	62.4
Boiler proportions:	
Tractive force, engine ÷ comb. heat. surface	9.05
Tractive force, engine x dia. driver ÷ comb. heat. surface	660
Firebox heat. surface ÷ grate area	3.19
Firebox heat. surface, per cent of evap. heat. surface	8.14
Superheat, surface, per cent of evap. heat. surface	21.6

Performance in Service

The basic principle in making the application was to reduce to a minimum the clearance between moving parts in the main driving mechanism of the locomotive and to keep these clearances at a minimum from shopping to shopping. The driving boxes are fitted with 0.010 in. total clearance in the pedestals and no wedges are used. There is practically no wear after 25,000 miles and experience has shown that approximately 150,000 miles can be operated without shop or enginehouse attention at this location.*

The rod bearings are assembled with zero radial clearance and actually this can be obtained within a tolerance of 0.001 in. The resulting absence of box pound and rod pound is very noticeable in the operation of the engine. With friction bearings there is a pronounced slapping of the rods when the engine is coasting or operating under small throttle opening, which is absent here. With anti-friction bearings the elimination of many of the heavy shocks and impacts to which the frame and motion work generally are ordinarily subjected reduces the stresses in these parts and lowers the maintenance on them.

The rod-bearing temperatures are atmospheric, plus 30 to 40 deg. F. The locomotive has operated satisfactorily at temperatures varying from 40 deg. F. below zero last winter in the Adirondack mountains to the present summer temperatures, with satisfactory lubrication and using the same grade of grease throughout.

Observations in service to determine nosing and side sway indicate that the engine is steady and has good riding qualities. Further tests and observations are to be carried out to determine all of the advantages and economies which may properly be charged to the application and to improve and extend its use as far as seems desirable.

* See *Railway Mechanical Engineer*, November, 1932, page 451, "Roller Bearings on Driving Journals Show Economies."

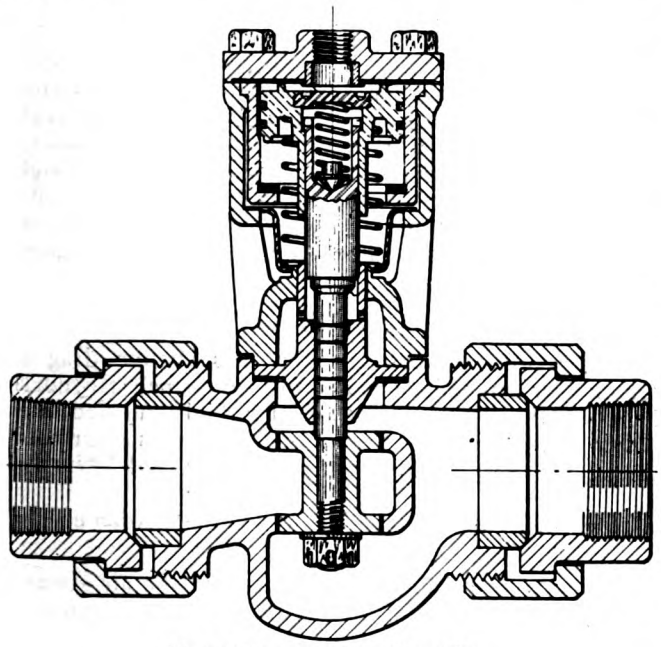
Steam Throttle Valve For Air Compressors

TO prevent racing and protect air compressors against damage when operating at low main reservoir pressure the New York Air Brake Company, 420 Lexington avenue, New York, has designed a special throttling valve which is inserted between the turret valve and the governor in the steam supply line leading to the air compressor on the locomotive. The function of this valve is to restrict the flow of steam to the pump at times when the main reservoir air pressure is extremely low, or during the start of charging the main reservoirs.

When charging is started in the main reservoir should there be an absence of air therein and full steam pressure is permitted to flow immediately into the air compressors, there is a tendency for the compressor to race due to the absence of an air cushion under the pistons. Oft-

times the pistons are forced so hard against the end of the air cylinders that the piston heads become loosened from the piston rods, resulting in a pump failure. To eliminate this it is proposed to restrict the flow of steam to the compressors until such time as the main reservoir air pressure is built up to a predetermined pressure, for example 40 lb., at which time a suitable air cushion behind the air pistons is established to permit full steam throttle opening without damage to the compressor operating parts.

Referring to the drawing, the left-hand opening of the lower portion is connected to the steam supply and the right-hand opening to the air compressor. Between these openings a plug valve is interposed. This valve is attached to a valve stem which is collapsibly connected to a piston in the upper part of the throttle valve, the space above the piston being connected to the air pipe leading from the main reservoir to the high pressure top of the duplex pump governor. While the pressure in the main reservoir is low, all parts are in the position shown and the flow of steam to the air compressor is restricted to the amount that can pass the loosely fitting plug valve.



Air compressor throttle valve

As will be noted, the piston is provided with a sealing rim on its upper face which seats on the top gasket so that only the surface inside of the rim is subjected to air pressure. When main reservoir pressure reaches about 40 lb., the piston is forced down against the resistance of the outer spring and opens the plug valve. As soon as the piston starts downward and the rim seal is broken, the effective area is increased to that of the full piston diameter. The piston will now make its full stroke, overcoming the resistance of both the outer and inner springs and seat itself against the gasket in the bottom of the piston chamber and thus prevent any leakage from the main reservoir to the atmosphere below the piston. The piston and valve stem being collapsibly connected, the downward movement permits the enlarged portion of the valve stem to seat against its guide and form a seal against steam leakage past the lower part of the valve stem to the atmosphere.

When operating against low reservoir pressures, the pump is limited to 40 to 45 cycles per minute and when the throttle valve opens, the speed is immediately increased to say 80 to 90 cycles.

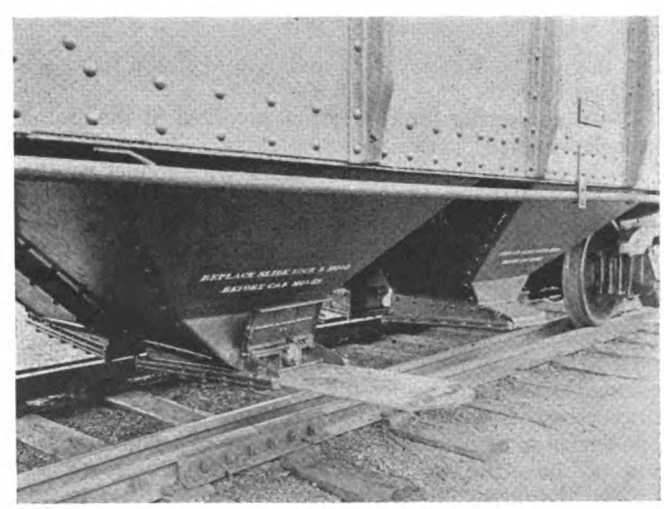
Discharge Gates for Bulk Cement Cars

THE growth of the use of ready mixed concrete, or batch mixed concrete, has made it necessary for several railroads to provide special cars for a more satisfactory handling in bulk of the required cement. The majority of these cars have been converted from 55-ton, twin-hopper, coal cars by the addition of a water-tight roof provided with covered hatch openings. Interior bulkheads are also fitted to limit the cubical capacity to suit the increased weight of cement, which averages about 85 lb. per cubic foot as loaded. The hoppers are modified from the usual door arrangement to that of special discharge gates which are suitable for use with the type of conveying system employed in unloading this material.

Certain railroads are also converting some box cars for the handling of bulk material, fitting them with covered roof hatches and with hoppers below the flooring, the discharge gates for these hoppers being similar to those used on the hopper type cars.

The Wine Railway Appliance Company, Toledo, Ohio, has developed for these types of cars a discharge gate having an electric steel casting frame which extends entirely around the hopper openings and is riveted thereto. Below this upper frame is secured a lower frame which carries the guides for the slide and grooves for the unloading connection, the contacting surfaces of the two frames being finished to assure a perfect assembly. Between these frame members is a sliding gate, provided with a handhole for operating, and a pawl for locking and sealing the gate in closed position. The operating end of the assembled gate is covered by a weather tight shield which may also be sealed. The whole gate is of rigid construction to prevent the weave in the car body from influencing the alinement of the frames, or the sliding member, and to withstand the hard usage of this service. These discharge gates are furnished by the manufacturer as a completely assembled unit ready for application to the modified hopper sheets.

There are other possible uses for cars of this type, such as the handling of lime, glass sand, furnace lining, pulverized coal, or almost any bulk material which must be kept dry in transit, yet can be unloaded by gravity to an advantage. Some of these, as well as certain other materials, are already being handled in limited quantities in covered hopper bottom cars.



Wine type "A" discharge gate for bulk cement cars—Near gate open and others closed with the weather shields down

Aerodynamics of the Railway Train

By Alexander Klemin*

Part I — Wind-tunnel experimental methods — Use of Reynolds' Number in determining scale effect

AS an introduction to the evaluation of the air resistance of the railway train, it is necessary to set down one or two fundamental formulae.

The fundamental equation of air resistance may be written in the form

$$R = C\left(\rho \frac{v^2}{2}\right)A$$

where

R = the resistance in lb.
ρ = the density per cu. ft.
v = the speed in ft. per sec.
A = the frontal area in sq. ft.
C = the absolute coefficient of resistance

Engineers very often prefer to combine the density with the constant C considering the density to be that of standard air at 60 deg. F. and 760 m.m. pressure, and also to use the velocity in miles per hour. The equation then becomes

$$R = K A V^2$$

where K = the "engineer's coefficient of resistance"
V = velocity in miles per hour.

This equation assumes that air resistance varies as the area and the square of the speed. While turbulent or eddy making resistance does vary in this fashion, skin friction follows a different law. Thus, skin friction varies as

$$bl^{.85} v^{1.85}$$

where b is the breadth of a flat plate and
l is the length of a flat plate

Dimensional analysis indicates that the eddy or whirling resistance and the viscous drag may be combined in the form

$$R = C \frac{\rho}{2} Av^2 \left(\frac{vl}{\nu}\right)^n$$

where n = a small negative exponent,
l = the length of the body
ν = the coefficient of kinematic viscosity.

The expression $\frac{vl}{\nu}$ is known as the Reynolds' Number.

The use of the Reynolds' Number and of the exponent n is two fold:

1—In correcting for the errors involved in the simple "velocity-squared" law.

2—In correlating full scale values with model results.

In comparative work it is generally possible to use the simple squared law. The appropriate use of the Reynolds' Number correction will be fully covered in these articles, even though space will not allow us to give its full theoretical derivation.

In considering train aerodynamics, some reference must be made to wind tunnel methods. In Fig. 1 is represented diagrammatically the wind tunnel at New York University, in which a large propeller type fan creates a powerful airstream in the working or experimental section of the wind tunnel. The methods employed for making the flow smooth and steady with as little pressure gradient as possible, and for control of the tunnel speed are interesting, but do not concern us here. In Fig. 2 are represented also diagrammatically the six automatic balances and suspension wires which are employed for making measurements. It is possible with such equipment to measure forces along three axes at right angles to one another, and also the moments about such axes.

Certain limitations as to sizes of models naturally exist and the model should not have a cross-section too large in relation to the size of the tunnel. By certain modifications of the New York University tunnel it is possible to test a scale model of say a locomotive and eight coaches to a maximum length of 25 ft. There is possible a wind speed variation of between 10 and 110 miles per hour. Such speed variation is useful in investigating scale effects.

Scale Effect

It is found in measuring the aerodynamic drag of rounded or streamline bodies for very small Reynolds' Numbers that the drag coefficient is high and decreases rather sharply as the Reynolds' Number is decreased. Once a certain critical boundary layer Reynolds' Number is reached, however, and the product $\frac{\delta v}{\nu}$ where δ = boundary layer thickness, v = speed of the air stream, and ν = coefficient of kinematic viscosity assumes a certain value, the flow changes from a laminar flow to a turbulent flow, and the drag coefficient thereafter assumes an asymptotic, or very slowly decreasing value. The coefficient of drag of a long cylinder when plotted against $\frac{dv}{\nu}$ (where d is the diameter of the cylinder) as in Fig. 3 gives a typical picture of the variation of the drag coefficient with the Reynolds' Number of the body

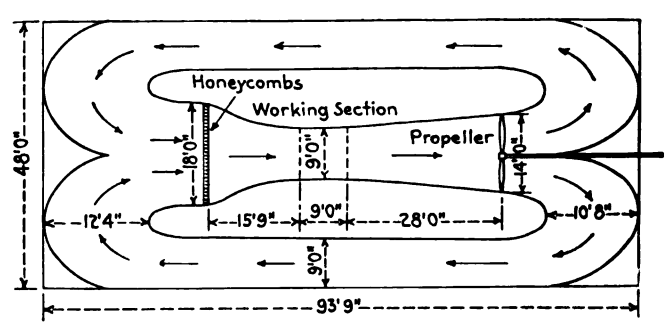


Fig. 1—Plan view of wind tunnel

* Professor in charge of the Daniel Guggenheim School of Aeronautics, New York University.

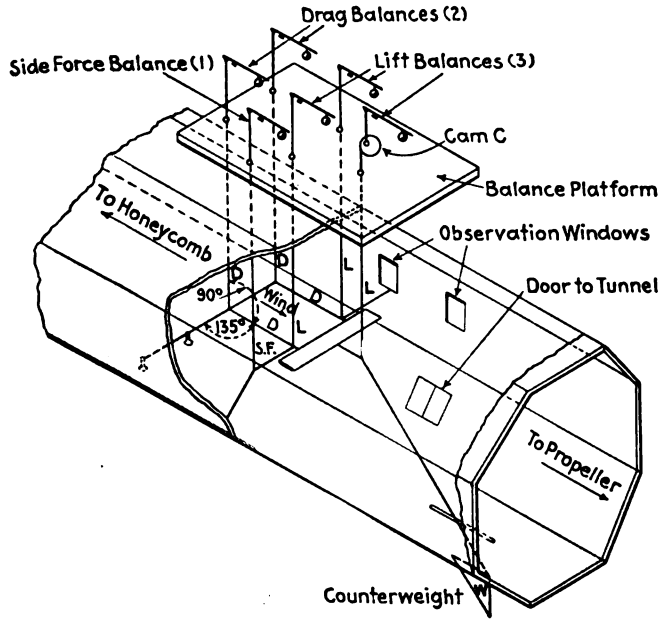


Fig. 2—Suspension of model to wind-tunnel balances

as a whole as well as its finally asymptotic character.

It is important therefore that test of trains should be made beyond the critical Reynolds' Number. Fortunately the critical number for streamline trains is only about 100,000[1] and this is greatly exceeded in a modern wind tunnel such as that previously described.

Once the critical number has been passed, extrapolation becomes fairly easy. Thus wind-tunnel tests made on air ships to a scale as low as 1:134 have been checked quite closely by full scale deceleration tests and the exponent n in the equation $R = C \frac{\rho}{2} A v^2 \left(\frac{lv}{\nu}\right)^n$ is found to have quite a low value even for a "fine," well streamlined airship. Again in wind-tunnel tests of various types of airplanes, the writer has found that n has a numerical negative value never greater than —.09, and computatives of airplane performance have been checked again and again by full flight tests with an accuracy regarding top speed of + 2 per cent.

For trains extrapolation for full scale resistance should be considerably easier than for either airships or airplanes. First of all, the scale of the model can be larger than in the case of an airship or a larger airplane. Second, the tunnel speed can be made equal to or greater than the speed of the train, whereas airplane flying speed may be several times as great as the tunnel speed. Again the train is not likely to be, for some time at least, nearly as perfect a streamlined object as the airship or the airplane at zero lift for the following reasons:

The railway train cannot be streamlined in plan form; neither the head car nor the tail car can be designed in perfect accord with streamline principles; the presence of the ground must destroy the symmetry of the flow to some extent; a train is likely to experience a cross-wind or lift force, and this in turn produces appreciable drag in an object as narrow as a railroad train. A justifiable hypothesis is therefore that while the law $R = C \frac{\rho}{2} Av2\left(\frac{vl}{\nu}\right)^n$ applies to the streamline train, the value of n should be much smaller than in the case of the airship or the very clean airplane. We will examine such experimental evidence as is available.

In the tests of a freely suspended 1:12 scale model of a C.N.R.[2] locomotive and tender the following were obtained for the resistance coefficient (including the suspension wires):

Wind speed ft. per sec.	$\frac{R}{V^2}$ x100
20	0.133
30	.136
40	.139
50	.139
60	.141
70.4	.140
70.8	.140
90	.141
100	.142
110.5	.142
120	.141
154	.142
170.2	.140

In spite of the fact that suspension wires were included in the measurements, the drag coefficient remained substantially constant beyond a speed of 50 ft. per sec. Certainly in extrapolating to full scale for an unstreamlined locomotive scale corrections would not be applied, and the $A v^2$ law followed exactly.

Early experiments by Dr. Klemperer at Friedrichshafen[3] on unstreamlined automobiles and cars streamlined on the Jaray principle showed the resistance to vary as v^2, independent of the Reynolds' Number, for all the types of cars tested.

Rumpler's experiments[4] at Göttingen also with varying types of automobiles gave the same result.

Professor W. E. Lay at the University of Michigan, also in tests of automobile bodies[5] ran the tunnel at various speeds but took average values throughout, indicating apparently that no scale effects were found. So did R. H. Heald at the Bureau of Standards.[6] Dr. Tietjens[7], discussing the effects of varying Reynolds' Number, concludes that once tests are run beyond a number of 100,000 coefficients will not vary greatly with scale effect.

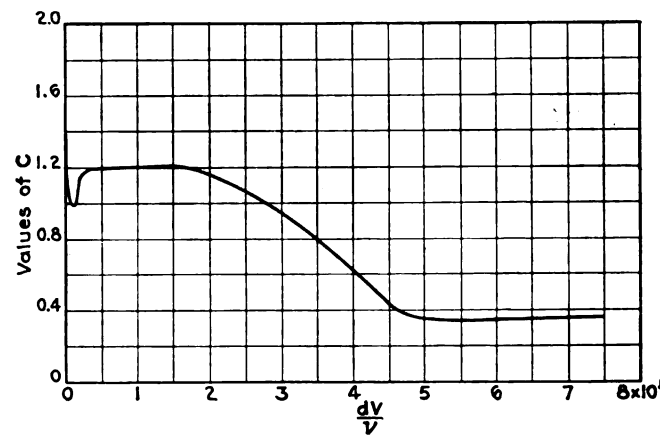


Fig. 3—Coefficient of air resistance for a long cylinder as a function of the Reynolds' Number

Tests on the model of a 1934 Sedan at New York

[1] Air Resistance of High-Speed Trains and Interurban Cars. O. G. Tietjens and K. C. Ripley. A.S.M.E. Applied Mech., Sept., 1932. See also the *Railway Mechanical Engineer* for Jan., 1932, page 18.

[2] G. G. Green, The Wind Tunnel Development of a Proposed External Form for Steam Locomotive, Canadian Journal of Research, 1933. See also the *Railway Mechanical Engineer* for May, 1933, page 149, and June, 1933, page 204.

[3] W. Klemperer, Luftwiderstands-Untersuchungen an Automobil-Modellen, Z.F.M., July 31, 1922.

[4] E. Rumpler, Das Auto im Luftstrom, Z.F.M., Heft 3 and 4, 1924.

[5] Fifty miles per Gallon with Correct Streamlining. S.A.E. Jan., 1933.

[6] Aerodynamic Characteristics of Automobile Bodies Bureau of Standards Journal of Research, Aug., 1933.

[7] O. G. Tietjens and K. C. Ripley, Air Resistance of High Speed Trains and Interurban Cars. A.S.M.E. Applied Mechanics, Sept., 1932, and *Railway Mechanical Engineer*, Jan., 1932, page 18.

University[8] gave a value for n of —.09 in free air, and —.06 in a test by the mirror method.

In tests at New York University[9] on a model of a modern streamline train, the value of the exponent n in the formula

$$R = C\frac{\rho}{2}Av^2\left(\frac{lv}{\nu}\right)^n$$

was only —.017 showing that for even a streamline train, the effects of scale are very small. In tests of a Jaray streamlined single car also at New York University n had a somewhat higher negative value, but the Jaray car had much more of the true airship type of form.

In experiments at the Berlin Technische Hochschule on a single unstreamlined railway coach, all the curves of the resistance coefficient plotted against wind speed tended towards asymptotic values. Typical values of n were as follows:

"Smooth" coach	—.07
Coach with windows, ventilators, etc.	—.05

Maurain[10] in tests of a French train composed of a locomotive, tender, coach and box-car found his non-dimensional curves of resistance to be practically parallel to the wind speed as the abscissa.

With unstreamlined automobiles, locomotives or trains it would appear to be quite safe to put $n = 0$. With well streamlined trains, test runs should be made at varying speeds as a check, but no serious errors will be made by assuming n also zero. The question of scale effect in wind tunnel tests of trains does not appear to have anything like the importance sometimes imputed to it.

No direct comparison between tunnel tests and full scale tests for complete train are as yet available. Comparisons for a single coach have been made by Vogelpohl[11] on the basis of his tunnel tests and full scale tests by Nocon.[12] The "Smooth" tunnel model gave 15 per cent less resistance than the full scale model. A tunnel model equipped with windows, ventilators, etc., gave only 5 per cent less resistance than the full scale test. The concordance is gratifying.

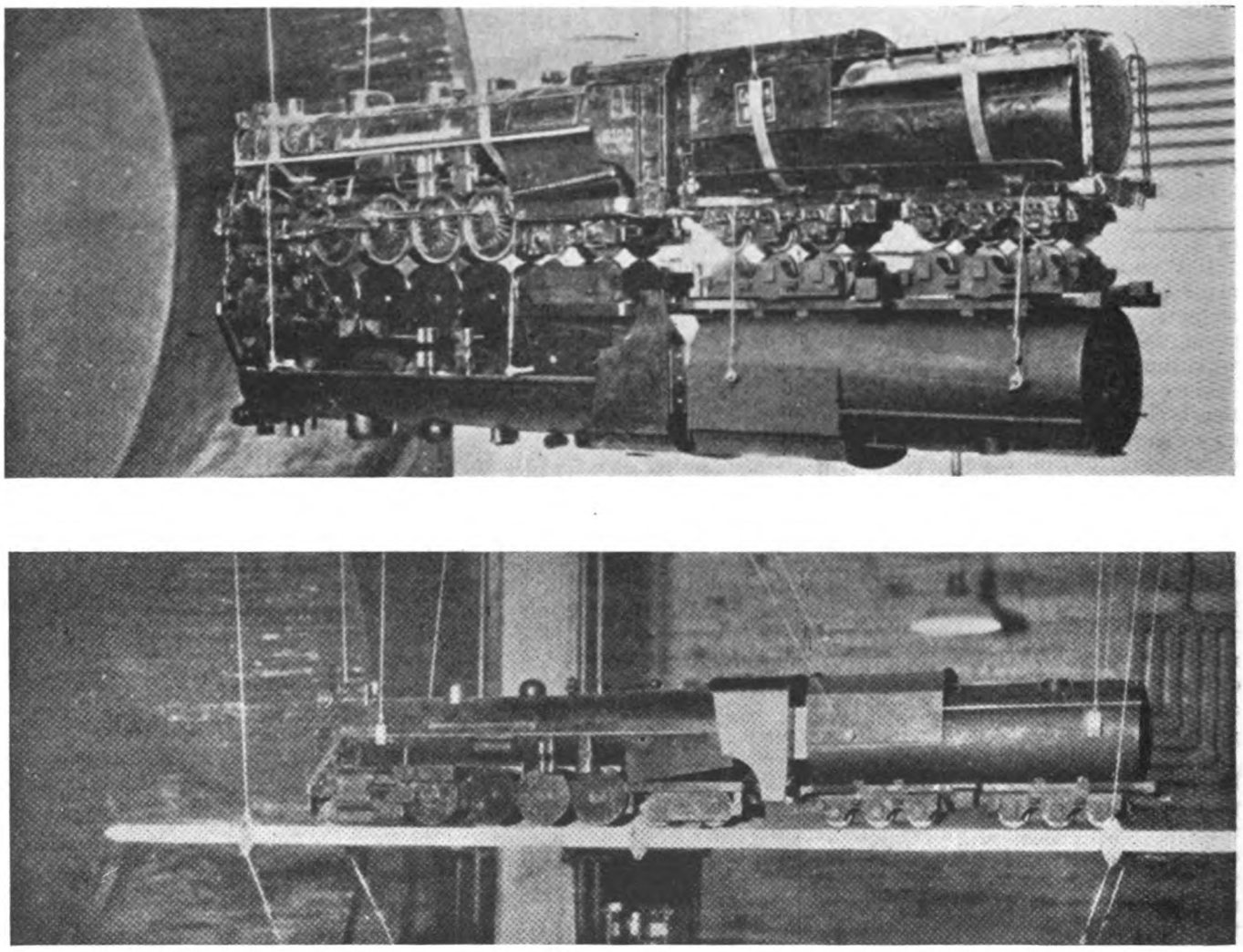


Fig. 4—Mirror and ground board tests for C. N. R. locomotive

Detail Construction of Models

Models should be as light as consistent with adequate strength, so as not to lessen the sensitivity of the balances. It should be possible to fasten models of separate coaches rigidly enough to obviate misalignment under

[8] Unpublished.
[9] Unpublished report.

[10] Ch. Maurain, Resistance de l'Air Sur les trains, Recherches et Invention, Nov., 1923.
[11] G. Vogelpohl, Luftwiderstand von Eisenbahn-Fahrzeugen. Z.V.D.I., Feb. 3, 1934.
[12] E. Nocon Glasers Ann. Bd. 108 (1931), P. 99.

wind forces. Finish of models should of course be as smooth as possible. Well seasoned mahogany or maple are excellent woods for model construction, and will keep their form indefinitely. In building models for an experimental test program, expense and trouble will be saved by using detachable noses or tail pieces, etc. Plasticine may be readily employed for experimental fairing.

A more difficult question in model construction is the representation of detail. The train model as a whole may be well beyond the critical Reyonlds' Number, but certain details whose linear dimensions are of course much smaller than those of the model as a whole, may in itself be below its own critical Reynolds' Number—as for example a projecting cylinder. Not only will small details of this sort have in themselves too great a resistance, but owing to the disturbed flow round them their interference with adjacent parts of the locomotive or train will be unduly severe.

Models should not be constructed to show too great detail. In airplane practice, when models of air-cooled engines are subjected to resistance tests, such details as overhead rocker arms and cooling fins are not reproduced. The cylinder is represented by extending its diameter to the outer dimensions of the cooling fins, and the head of the cylinder is simply rounded off.

Certain details may be removed and their resistance subsequently allowed for by calculation or independent test.

Common sense and aerodynamic experience should allow questions of detail reproduction to be settled. Where doubt exists, it is always possible to test cer-

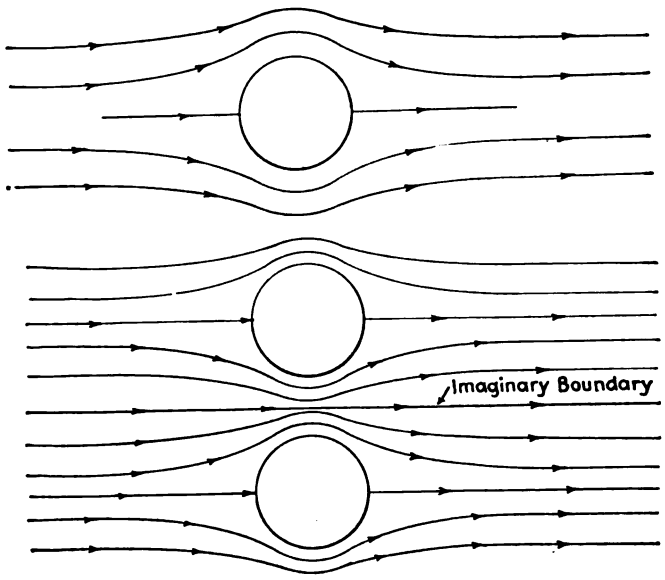


Fig. 5—(Above) Theoretical flow past a cylinder—(Below) Flow past two identical cylinders showing imaginary boundary

tain parts of the model to a much larger scale; and thus arrive at an estimate of the real effects of interference and scale effect on details.

The amount of detail in the model of the C. N. R. locomotive[13] as tested at Ottawa is shown in Fig. 4. In Göttingen[14] experiments on two high speed electric cars, door handles, window sills, and such details were omitted.

Theoretically the wheels of a train should be in circular motion when tests are made in the tunnel, since the resistance of a rolling cylinder is greater than that of a stationary one. No information is available, but the problem should not be one of more than secondary importance.

[13] loc. cit.

[14] Ergebnisse der Aerodynamischen Versuchsanstalt zu Göttingen, III Lieferung, p. 162.

Ground Effects—The Mirror Method

When a train is in motion over the ground, the air at the nose is brought into motion by impact; that at the sides by adherence in the boundary layer. The effect of the train on air diminishes with the distance from the train, so that the actual surface at the ground should be of comparatively little importance. Further the projections of cross ties and roughness of gravel are small in relation to the other dimensions of the train.

In Fig. 5 is shown the theoretical flow past a cylinder. If as in Fig. 5 two identical cylinders are disposed then the flow is as represented and it is seen that no air flows past an imaginary boundary, parallel to the line of air flow, and placed half-way between them. Hence a "mirror" cylinder will simulate the presence of the ground. It is on this simple principle that the "mirror" method of wind tunnel testing for ground effect is based (as illustrated in Fig. 4).

Granted that the actual surface of the ground is of little importance, then ground effect on a train should be simulated by disposing two identical trains, one in upright position and one in inverted position, and in such fashion that the distance between two similar points is twice the distance of these points from the ground. The only aerodynamic objection to the mirror method is that vortices are produced periodically, and that vortices for the upright train and for the inverted train are not likely to be produced at exactly the same instant. Hence the mirror method is open to the objection that while the bodies tested mirror one another, the flows do not.

A more practical objection to the mirror method is that it involves additional expense in the duplication of models and in the additional time and effort in testing. Granted even that the mirror method is fairly sound theoretically, it would be an advantage to use some simpler method of test.

The Free-Air Method

In the free-air method the model is simply suspended in the tunnel without "mirror" or "ground board." This of course is the simplest of all methods.

The free-air method is open to obvious objections. The air is not constricted by the presence of the ground; the flow over the lower part of the train model is evidently faster than it should be; there are two unrestricted sources of vortex or eddy formation at the front portion of the train. Therefore, it may be expected that the free air resistance will be greater than is really the case.

Ground-Board Method

Another method of test is to introduce a ground board under the model to be tested, as shown in the lower portion of Fig. 4. This is open to the theoretical objection that owing to the formation of a boundary layer on the ground board, the air is slowed up below the train, and the resistance may be unduly decreased. Attempts have been made by Professor Lay to remove the boundary layer by application of suction to the under side of the ground board; but such attempts have not proved very effective.

Moving Belt Developed at New York University

The one method which is absolutely free from theoretical objection is the use of a moving belt placed under the body to be tested and moving at exactly the same speed as the air. Here the constriction of the ground is

present yet there is no retardation of the air flow by the presence of a boundary layer on the ground board. Such a method was assayed by Eiffel some twenty years ago, but failed owing to the flapping of the belt. Under the writer's direction the method was revived and with careful mechanical design and some cut-and-try experimentation proved entirely successful. The moving belt method is illustrated diagrammatically in the sketch of Fig. 6.

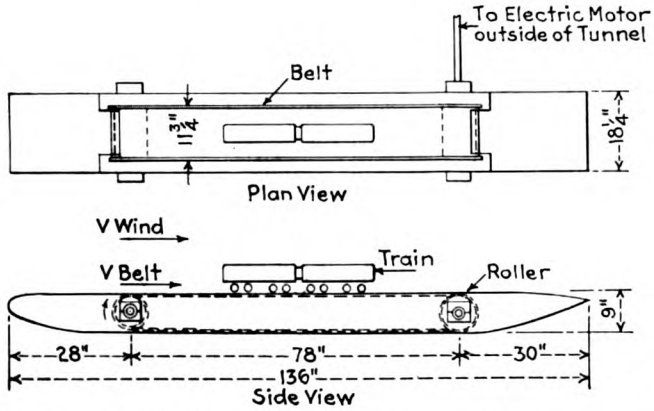


Fig. 6—Endless leather belt running on rollers at same speed as air in tunnel

Thanks are due for the encouragement and cooperation of the American Locomotive Company and the American Car & Foundry Company in this experimental work.

Comparisons of Various Methods of Tests

In the following table are given the representative drag values obtained with a model of a locomotive and tender, and a coach, in the form of a fairly well streamlined model, obtained at a wind speed of 60 miles per hour.

1—Mirror method	.49 lb. drag
2—Free Air	.55 lb. drag
3—Ground board	.38 lb. drag
4—Moving belt	.38 lb. drag

The concurrence between the ground board method and the moving belt was quite close at other speeds of tests, and the scale index *n* was the same for both methods. The free air always indicated the greatest resistance which is entirely in accordance with theoretical considerations. An exploration of the velocity in the presence of the ground board indicated moderate slowing up of the air flow and that only to the rear of the model.

From these tests, conducted with considerable care, the practical conclusion may be arrived at that simulation of the ground is essential. It may further be concluded that where a train model is near the ground and trucks impede the flow near the ground, the reduction in drag introduced by the retardation of the boundary layer of the ground is negligibly small.

This is a very important result for the technique of train testing in the wind tunnel. Since moving ground is now available it should always be preferable to test with a moving belt. But for comparative work the simple ground board method should be adequate.

Of course further experimentation will be necessary to verify the above conclusion, and for any new shape or varying length of train, comparison with the moving belt test should *always* be repeated.

For automobiles, the situation is entirely different. In automobiles the moving belt method is the only one that is thoroughly valid. To discuss ground effects in the automobile is however beyond the scope of this article.

[Part II will take up head-on air resistance for locomotives and trains.—Editor.]

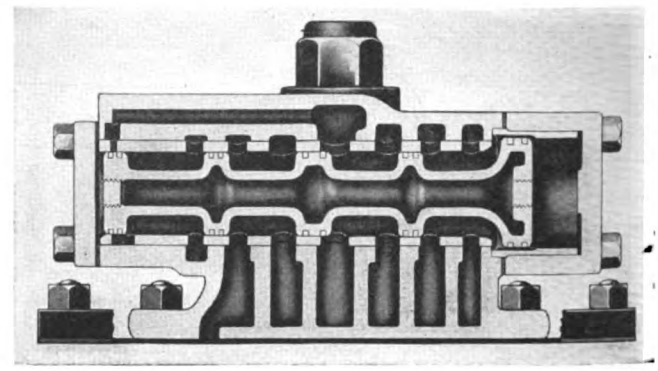
Top Head for Cross Compound Compressors

THAT the 8½-in. cross compound air compressor for air brake service may now be furnished with a new type of top head embodying improvements designed particularly for high temperature and high pressure steam conditions, yet none the less valuable for general use, is announced by the Westinghouse Air Brake Company.

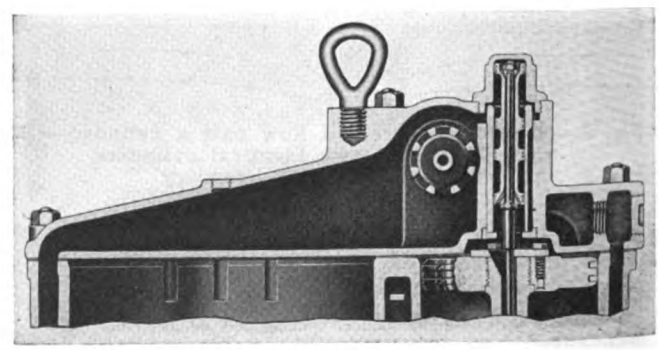
A reversing valve of the piston type replaces the slide valve type. The evils of high friction, intensified by higher steam pressures and temperatures are thereby eliminated. There is, therefore, less strain on the reversing valve rod, and, since reversing action is positive, better general all around compressor performance is obtained.

The main valve piston is now made in a single casting, instead of bolted segments, to insure maintenance of alignment. The four small pistons are of equal diameter and operate in a single bushing; the former small bushing in the cylinder cover is eliminated, and the large piston bushing is now in the cover. This improved construction simplifies assembly, fitting, and repairs and there is one less ring to stock.

The steam pipe connection can now be made directly to the top head, thus eliminating one of the most common head gasket troubles, i.e., leakage from the steam supply passage into the top end of the high-pressure cylinder.



Top head of 8½-in. cross-compound air compressor showing improved main piston



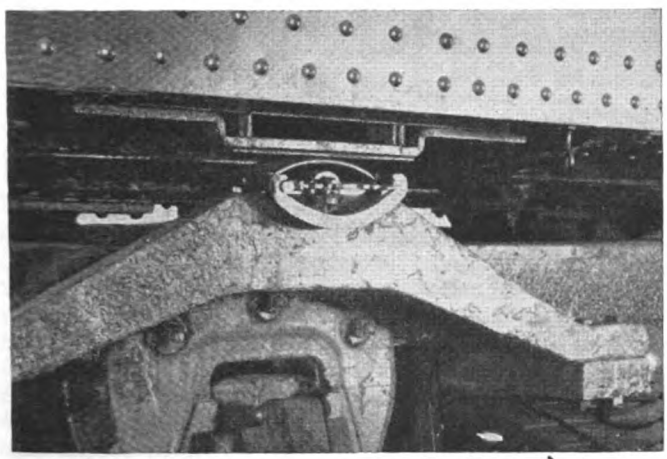
Top head of 8½-in. cross compound air compressor showing piston type reversing valve

With this arrangement the steam passage in the cylinder is separated from that of the top head by a plug, and the pipe connection for the former left open to avoid possibility of water freezing in the cylinder passage. The present method of connection may still be used, however, by a mere transfer of plugs.

Shock Absorbing Side Bearing

A NEW type of side bearing for passenger-train cars, developed and tested during the past two years by the Railway Products Company, 5949 Superior street, Chicago, is designed to include a shock-absorbing feature in its construction, as well as to provide a gradually increasing resistance to car roll under all conditions. It also promotes ease of truck swiveling, elimination of noise, and freedom from maintenance difficulties. The initial application of this side bearing was made to a steel dining car of the Chicago & North Western, on which it is reported to have given satisfactory service for a period of over 18 months, with frictional wear negligible and no adjustments, repairs, or replacements required.

This side bearing, which is called the RPCO (Drews) type, can be applied without any change in the construc-



Application of RPCO (Drews) shock-absorbing side bearing on a steel dining car of the Chicago & North Western

tion of car body or truck. It is simply bolted to the side bearing arch of the truck with two ½-in. bolts through an adapter plate which replaces the friction plate usually provided. The RPCO bearing, itself, comprises essentially a cast-steel base plate, which is capable of sliding movement at one end in a saddle casting to provide the small extension in length required when the supporting springs are compressed. These springs include an arched spring plate which bears against the car body side bearing and two truss springs located one on either side of the truck side bearing. In operation, when the car body rolls, the arched spring plate is flattened, slightly extending the length of the base plate, and, therefore, deflecting the truss springs. In other words, the movement of the car body in rolling is resisted by the combined spring action of the arched spring plate and the two truss springs, the motion being definitely stopped by a limit block cast on the base plate.

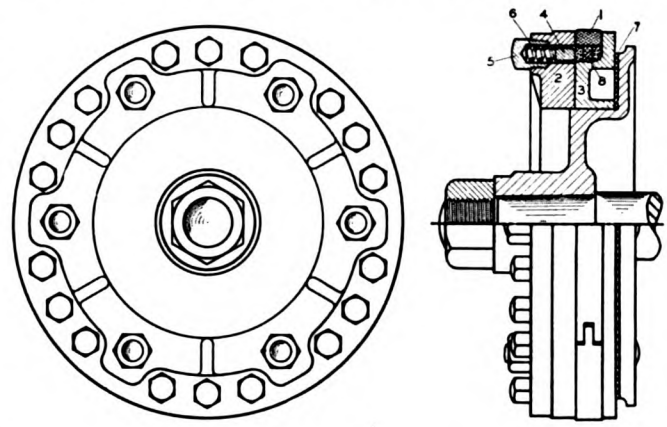
With this type of side bearing, clearance is unnecessary, and maximum flexibility is secured with the total elimination of noise and shock. Other advantages are the reduction of frictional area from 52 sq. in. for the standard bearing to one sq. in. maximum for the RPCO bearing, with consequent reduction in friction. Ease of assembling or dismantling is assured, also the avoidance of frequent side bearing adjustment and repair. Shocks usually transmitted from rail and rail joints through the body side bearing are absorbed and additional cushioning provided for truck and body parts. Should any part of the RPCO side-bearing break for any reason, the car would ride safely, as the limit block is the highest point in the assembly after the arched spring plate is removed, and the car would ride on the limit block.

The way this side bearing is designed to operate with a car on curves is as follows: When the car is nosing into a curve, the centrifugal force moves it over onto the side bearing, which is on the outside of the curve. This swings the car off the center line of the rails, due to the swing hanger arrangement of the truck, producing a greater load on this side of the truck (which is desirable) and thereby preventing the wheels on this side from climbing the rails. The flexible side bearing aids this condition by placing an additional load on this side of the truck until the car has reached the banked portion of rail when it aids in gently but flexibly moving the car body over towards the inside of the curve. When the car comes out of the curve, the side bearing aids in straightening out the car, and any shocks due to irregularities in the rail, rail joints, sticking journal boxes, eccentric or out-of-round wheels, etc., are flexibly cushioned on curves as well as on straight track.

King Cylinder Packing For Power Reverse Gears

THE packing ordinarily used in power reverse gears is of the molded cup form, the cup being composed of asbestos and rubber which is formed into shape and the rubber then vulcanized.

Some time ago the Interstate Commerce Commission issued an order to equip power reverse gears with steam connections. The object of this order was to secure added



King packing for reverse-gear cylinders

safety so that if there should be a broken air connection to the power reverse gear it could still be operated by steam to reverse the valve motion. By reversing the engine and closing the throttle the main cylinders of the locomotive would act as air compressors and the resistance thereby set up would in course of time bring the locomotive to a standstill. Since steam connections have been applied to power reverse gears, there have been a number of engine failures brought about by the emergency use of steam in these gears, which has the effect of disintegrating the molded rubber and asbestos cups.

To meet this situation the United States Metallic Packing Company, Philadelphia, Pa., designed the King cylinder packing shown herewith. Ordinarily no alterations are made in the piston head, but the existing

molded cups, bull ring and follower are removed and discarded. In their place is applied gasket *7*, bull ring *3*, and King cylinder packing ring *1*. Three turns of soft fibrous packing are then applied in the cavity left between the King cylinder packing ring *1* and the bull ring *3*. This fibrous packing is made of pure asbestos—no rubber enters into its composition—so that there is nothing to deteriorate from the effect or temperature of the steam. Follower *2*, with expander *4* in place, is now fitted over the studs which held the former assembly in place, nuts are applied to the studs and drawn up tight. Springs *6* and caps *5* are inserted and pulled up tight. These springs exert a constant pressure on the fibrous packing and prevent leakage of pressure between parts *1* and *2*, and between parts *1* and *3*, and also provide a resilient body to support the King packing ring *1*.

Bethlehem High-Speed Auxiliary Locomotive

A MODERN freight locomotive must be capable of developing a large horsepower at operating speeds in order to handle modern trains. Present requirements demand higher speeds as well as greater power. The need for larger boiler capacity is now generally recognized and a locomotive that can meet present demands has ample boiler capacity. The ability to make time on a fast schedule, however, depends not merely upon maintaining a high running speed, but also upon the ability to accelerate a heavy train to full speed in the shortest practical time. At starting and at the lower range of speeds the main cylinders of a locomotive can not, however, utilize the full steaming capacity of the boilers now provided. In order to utilize this surplus boiler capacity at low speeds and thereby add to the starting power and also increase the rate of acceleration, some auxiliary power means must be provided. These facts are by this time quite generally recognized and, consequently, such an auxiliary is properly becoming a fundamental part of any modern locomotive unit.

In order to make available an auxiliary locomotive capable of overcoming the inherent limitations of the conventional locomotive in the lower range of speeds as described and which, in addition, can be used in high-speed freight and passenger train service, a new type of auxiliary locomotive, Series H, has been designed, constructed and thoroughly tested by the Bethlehem Steel Company, Bethlehem, Pa. The illustrations will serve to show the general construction of the new design while a reference to the table will give a comparison between the Series H and the older Series A and S.

Compared to the older four-wheel Series A and the six-wheel Series S auxiliary locomotives, both having 36-in. wheels, the high-speed Series H machine with 42-in. wheels has slightly lower starting tractive force with the same boiler pressure and slightly greater tractive force beyond a speed of about eight miles an hour. Also, due to the larger wheel diameter and to a reduction in side-rod length from 80 to 60 in., the rod stresses of the Series H machine at any given high speed are slightly less than 50 per cent of the Series A and S machines. As a result of being so proportioned the Series H machine is capable of running at speeds of at least 100 m.p.h. without developing excessive stresses in the side rods or other parts of the truck.

General Data on Bethlehem Auxiliary Locomotives

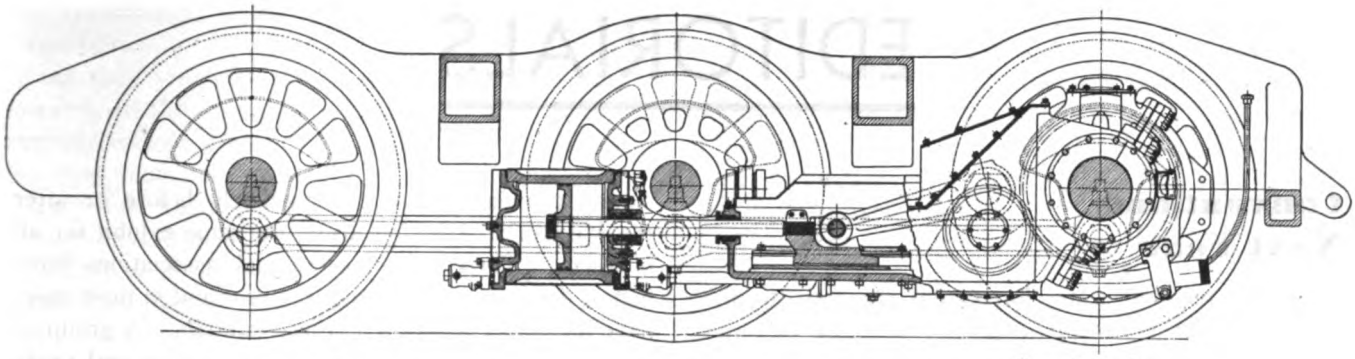
Detail	Older Series A and S	High-Speed Series H
Cylinder diameter, in.	12	12¼
Piston stroke, in.	10	11
Gear teeth:		
a. Driving pinion	16	21
b. Axle gear	36	47
Gear ratio, 1 to	2.250	2.238
Diameter of drivers, in.	36	42
Piston data:		
a. Area, sq. in.	113.10	117.86
b. Displacement, cu. ft.	0.6545	0.7503
Revolutions per mile:		
a. Drivers	560.2	480.0
b. Crankshaft	1,260.50	1,074.24
At a train speed of 1 m.p.h.:		
a. Drivers, r.p.m.	9.34	8.0
b. Engine shaft, r.p.m.	21.01	17.90
c. Piston speed, ft. per min.	35.01	32.82
d. Piston displacement, cu. ft. per min.	27.50	26.86
Cut-off, per cent	70	70
Cylinder tractive force at any train speed	90.0p*	87.96p*

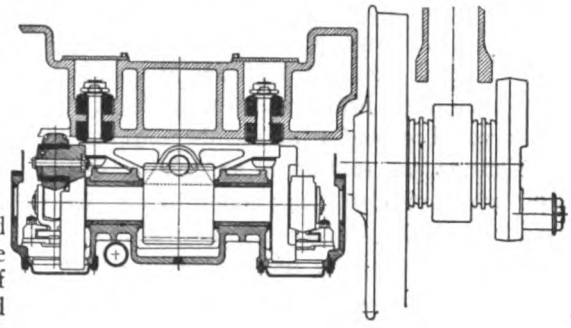
*p is mean effective pressure in lb. per sq. in.

The Series H auxiliary locomotive is mounted on a Commonwealth, fully-equalized, six-wheel, cast-steel truck frame, with axles uniformly spaced on 60-in. centers. The wheels are 42 in. in diameter with heat-treated steel tires and S K F roller bearings are provided on all three axles. The brake gear is of the full-floating clasp-brake type. The engine is of the two-cylinder type with piston valves and cylinders 12¼ in. in diameter with 11-in. stroke and coupled to the driving axle at a gear ratio of 21 to 47.



Bethlehem high-speed auxiliary locomotive, Series H, applied to tender of Lehigh Valley 4-8-4 type freight locomotive





Sections of Bethlehem high-speed auxiliary locomotive, Series H, applied to a six-wheel truck

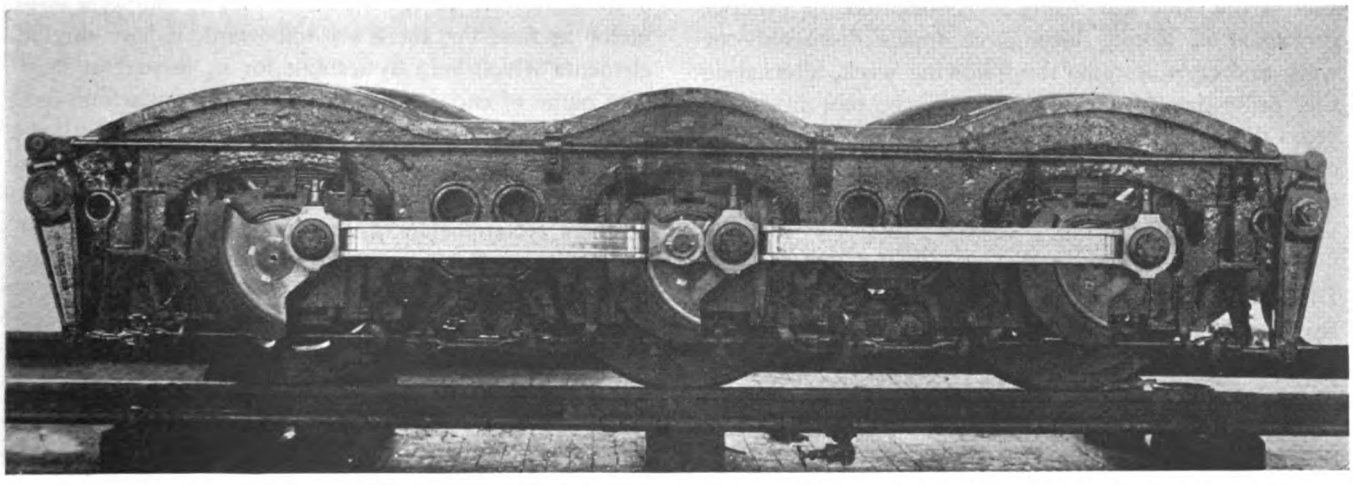
In order to provide the maximum of strength and durability special materials are used for many of the more important parts. For example, the engine frame is of manganese molybdenum cast steel specially heat-treated for high ductility and maximum strength. The side rods and side-rod cranks are nickel manganese steel, heat treated. The engine pinion shaft with integral driving pinion and cranks and other important details are of 3½ per cent high-grade nickel steel, heat treated. Piston rods and valve stems are of stainless steel. Journal boxes and many castings are of electric-furnace steel.

By the use of 42-in., instead of 36-in., wheels a greater maximum wheel load capacity is provided and the number of revolutions per mile is decreased. This, with the shorter rods, makes it possible to use the Series H auxiliary locomotive with any high-speed locomotive at the highest possible speeds. All parts come within the A.R.A. third-rail clearance lines. The design is suitable for application on either the front end or the rear end of the tender.

The auxiliary engine is operatively connected to the driving axle automatically when the auxiliary engine is cut-in and is disconnected automatically when the auxiliary engine is cut-out. The train speed at which the machine can be cut-in or cut-out is limited only by the inadvisability of operating it under steam at a speed beyond which it would not deliver sufficient additional drawbar pull to warrant its use. The control of the Series H auxiliary locomotive is provided for by the two levers of the duplex control valve—one for steam supply and the other for the cylinder cocks. The duplex control valve is so interlocked with the reverse lever of the main locomotive that the auxiliary locomotive can not be cut-in unless the reverse lever is set for forward motion.

Bethlehem Series H high-speed auxiliary locomotives were applied to the tenders of ten 4-8-4 type locomotives built for the Lehigh Valley in the spring of 1932, for high-speed heavy freight service. These locomotives carried a boiler pressure of 250 lb., had cylinders 27 in. by 30 in. and 70-in. drivers. The rated cylinder tractive force of the locomotive itself was 66,400 lb. The tender weighed 398,330 lb. in working order and had a capacity for 20,000 gal. of water and 30 tons of coal. The auxiliary locomotive applied to the rear of the tender had a rated tractive force of 18,360 lb. Tests showed that at starting it added 17,570 lb. to the drawbar pull, 12,540 lb. at 10 m.p.h. and 6,720 lb. at 20 m.p.h.

The performance of these auxiliary locomotives has been excellent. A check of the tires on one truck after 20,000 miles of high-speed service showed less than $\frac{1}{16}$ in. tread wear which was uniform on all wheels. There was no perceptible wear on any of the flanges.



Side view of Bethlehem Series H high-speed auxiliary locomotive for six-wheel tender truck

EDITORIALS

Conventions Next Year

We have received some interesting reactions to the interview with a railway executive and the editorial comment relating to it, which appeared in our July number, suggesting a revival of the mechanical conventions. The General Committee of the Mechanical Division of the American Railway Association, at its meeting in June, voted to hold a full membership meeting in 1935. Nothing was said about an exhibit, since that is a matter which requires joint action by the Mechanical Division and the Railway Supply Manufacturers' Association. One of the reasons advanced for holding the convention next year, however, was that during the long interval between the conventions a sufficiently large number of new appliances, tools, equipment specialties, etc., had been developed to justify the special study and consideration of mechanical department officers. This would seem to infer that exhibits will be welcome if the railway supply manufacturers can see their way clear to co-operate.

The exhibits at the Atlantic City conventions have grown to enormous proportions. The manufacturers, however, have felt justified in going to the heavy expense involved, because under former conditions the exhibit extended over a period of seven or eight days and a large number of railway officers and foremen attended the conventions and visited the exhibits.

The extensive exhibit was made possible because in the early days it was the custom for the American Railway Master Mechanics' Association and the Master Car Builders' Association to schedule their meetings so that one of them would meet on Wednesday, Thursday and Friday of one week, and the other on the following Monday, Tuesday and Wednesday. When these two associations were combined into the Mechanical Division of the American Railway Association the practice continued of having locomotive topics discussed one week and car questions the following week, alternating this order from year to year. Then, too, in recent years the Purchases and Stores Division of the American Railway Association has met at Atlantic City for three days during the period that the mechanical conventions were in session.

The question now being asked is, will the Mechanical Division go back to the old practice of holding six sessions extending over an eight-day period, or will it try to confine its sessions to a shorter time? If so, there is a grave question as to whether the railway supply manufacturers will be warranted in going to the expense of setting up the exhibits for the shorter period. The suggestion has been advanced that some arrangement might be made to have the minor mechanical association conventions meet immediately before or after the Mechanical Division, using the same exhibit for all of them. These other mechanical associations have met at different times during the year and in most cases have had small highly specialized exhibits. A group of railway supply representatives suggested several years ago that it might be wise to hold all of the conventions at about the same time, thus making it possible to combine the exhibits and ease the burden on the supply companies. The depression, however, interfered with the working out and actual application of this scheme.

The suggestion now comes from several sources that the Mechanical Division and all the other mechanical associations get together and co-ordinate their programs and meetings, so that one large exhibit can be held for all of them. One objection to holding all the minor conventions at the same time is that too much of the supervision will be off the job. This might be partially overcome by holding some of the meetings in advance of the Mechanical Division meeting and some following it.

The Sayre Shops

The Lehigh Valley has been successful in applying the progressive spot system of locomotive repairs to its transverse type shop, the technical details being fully outlined in an article elsewhere in this issue. Only part of the story is told, however, since the article makes no reference to a rather intangible, but nevertheless extremely important, element in the success of the project—personnel relations.

One is impressed with the orderliness of the shop and the noticeable absence of confusion. The system of handling the various operations is, of course, a large factor in this, but there are important, if less tangible elements which help to account for it, in part at least. The name of each worker in charge of a machine or a job is prominently displayed, in the latter case with the designation of the class of work for which he is responsible. The workers naturally take a greater pride in their accomplishments, and undoubtedly this innovation does much to encourage higher ideals of craftsmanship.

Back of all this, however, is a still more important element. The employees have an organization to represent them known as the Maintenance of Equipment Association. Committeemen represent the different crafts in all departments throughout the plant and it has never been necessary to carry a grievance beyond the superintendent of motive power. Subsidiary to

this organization is the Sayre System Shop Athletic Organization, of which one of the workmen is president. It not only promotes athletic sports, but maintains a cafeteria in the assembly hall, and has done much to promote welfare work. The assembly hall is located in the shop plant, having been converted from one of the former shop buildings, and to a considerable extent is the center of community social activities. The Ladies' Auxiliary is largely responsible for this. It numbers about 2000 members and has provided clean entertainment for shop affairs, and has also stimulated a considerable amount of charitable work.

Technical methods, of course, have their place and cannot be minimized. A friendly family spirit, a pride in craftsmanship, cleanliness and orderliness are also essential factors in the successful operation of any organization.

Roller Bearings Go Marching On

The initial application of roller bearings to trucks of passenger-train cars in this country was made some twelve years ago. Today, in drawing up plans and specifications for new passenger-train equipment or for rail motor cars it is doubtful whether any road would neglect at least to consider the use of roller bearings and the probability is that such bearings would be specified as they have come to be considered a part of modern equipment, the additional cost of which is fully warranted in view of improved performances and reduced operating costs.

For freight-train service experimental installations have been made, but interchange and economic conditions have so far prevented their adoption for this class of service. However, in the last report of the A.R.A. Lubrication Committee the inadequacy of the present standard journal box with its brass, wedge and waste lubrication practice was pointed out and the committee was instructed to develop a program of test procedure with an estimate of probable costs in connection with an investigation of improved lubrication methods. While this did not mean roller bearings, it did indicate a feeling that something better than the present practice would have to be adopted in the future.

After the success of roller bearings in passenger-train service had been demonstrated, it was natural that their use should be extended to locomotive service, particularly as the lubrication of engine-truck journals had always been a source of more or less anxiety to engine-terminal forces. A few engine trucks were equipped with roller bearings some seven years ago and further application to trailer and to tender trucks followed soon after. At the present time a considerable number of such trucks have been equipped and are reported to be giving good service. In 1930 roller bearings were applied to driving axles and a number of locomotives are now so equipped. Some 75 electric locomotives have also been equipped with roller bearings on all axles. The next step forward was the application of roller bearings to main and side rods. Some interesting problems in design and in counterbalancing were encountered, but operation in heavy passenger service would indicate that there are no inherent difficulties. Thus another important step forward has been made.

Roller bearings have also been applied to many boosters and auxiliary locomotives. Another point where the use of roller bearings appears to be desirable is in valve-motion work. Thus far applications have been limited to transverse levers of valve gears for three-cylinder locomotives, but it is anticipated that they will soon be applied at other valve-gear points. Roller bearings have been of material service in increasing locomotive availability in hard service and on long runs. At whatever point they have been applied wear has been practically eliminated and but little attention to lubrication, adjustment or maintenance has been required—in short, roller bearings assure a long trouble-free life. The importance of extending their use has been recognized and this is very properly one of the subjects assigned to the A.R.A. Research Committee for investigation. A report is looked forward to with much interest.

Stand on Your Feet And Get Your Message Over!

The late C. H. Markham, of the Illinois Central, was widely and favorably known as a public speaker of force and ability. And yet, there are friends of Mr. Markham who can recall when in his earlier career he was more or less a failure in this respect.

There was a time when railroad officers did not appear much in public; today, the ability to speak effectively before an audience is a necessary part of their equipment—or should be. This is true not only of the executives and department heads, but is becoming increasingly important for supervisors and foremen, and is frequently a valuable asset for the man in the ranks.

An operating officer of prominence, when asked what was the most important thing that he had received in his four years at college, replied, "Membership in the literary society, because of the experience and training I received in public speaking." As a railroad officer he has consistently encouraged and helped his subordinates to learn to speak to an audience—and undoubtedly in some instances, at least, it has been a considerable factor in their advancement to more important positions.

The general manager of another railroad, impressed with the necessity of cultivating ability as a public speaker, encouraged a number of his associates to join with him to form a class. They retained an expert

to coach and instruct them; excellent results followed.

These thoughts are suggested by the interview with a public relations officer which appears on another page. The very existence of the railroads is at stake, unless the public can be fully aroused to the necessity of fostering them in the public interest. As pointed out in the interview, mechanical department officers and employees have a large opportunity and responsibility in this matter. Frequent opportunities for addressing groups of all sorts will open up to the man who is competent to speak to such audiences.

The ability to address an audience effectively is also a large asset on the job itself. An officer or foreman should be able to stand on his feet and make his points clear and convincing, in dealing with his associates and higher officers, as well as with his subordinates. Incidentally, also, the effectiveness of railroad associations and clubs would be greatly enhanced if the members took the matter of public speaking more seriously. It is almost pathetic to sit in even a small meeting of picked members of the mechanical department and try to follow men who are discussing problems of prime importance, but who can only be heard by those fortunate enough to sit within a few feet of them. The progress and achievements of associations have suffered seriously from these deficiencies in the past.

The American Society of Mechanical Engineers, realizing that important sessions of its annual meeting were suffering greatly because of inexperience of speakers in addressing even small audiences, retains a public speaking expert to come one-half hour each day before its sessions open, to make practical suggestions to the speakers as to how they can get their messages over more effectively. Engineering societies are bringing pressure on engineering colleges to make English and public speaking mandatory in their courses.

How can a railroad man get instruction and training in public speaking? In many cities and towns the public school system, the Y. M. C. A., or some other organization sponsors such courses. There are excellent books on the subject which can be studied with profit. The important thing to do is what many men have done with success—join some club, or group, or organization, where you can get practice, for, after all, that is of first importance, particularly if one is willing to discover a few simple rules and attempt to apply them.

The public relations officer interviewed spoke enthusiastically of supervisors' clubs on his road, which have proved most helpful in developing speakers who have given a splendid account of themselves, both within the organization and also in dealing with the public. Some of the supervisors' and foremen's clubs have fallen by the wayside in recent years. Some have come through with flying colors in spite of almost insuperable handicaps. More power to them! Let us hope, also, that with the larger demands and responsibilities upon mechanical department officers and foremen, new clubs will spring up which will give opportunity for training and practice in speaking to an audience. Indeed, these clubs could well afford to give specific attention to the problem of encouraging their members to take part in the discussions, with the deliberate intention of training themselves in public speaking.

Another Step in Locomotive Repair Methods

To many who have not been in intimate contact with the work of locomotive repair shops it might seem that the methods for performing this work have not undergone very much change in recent years. A brief review of what has actually transpired will show that the railroad shop has actually taken advantage of many practices that have been successful in other industries.

One need not look back so many years when labor was considerably less expensive and the pressure of demand for shop output was less severe to find that the problem of repairing a locomotive was principally that of placing it in a fixed location in the shop and removing, repairing and re-applying its parts without much thought being given as to the actual time the locomotive need be returned to service. As labor became more expensive and as traffic increased, pressure was gradually put on the shop to find not only more economical practices but those which would assure a substantial reduction in the number of days required by the shop to overhaul a locomotive. Then, too, the size of motive power was rapidly increasing and this complicated the problem of repair work.

In other industries, notably electrical-equipment and automotive, there came into being what has since been popularly called "production methods" and because of the outstanding success of such methods in those industries the railroads gradually became the target of those industrial modernists who thought that what was good medicine for manufacturing industries should be equally good for the railroad shop regardless of the fact that one is manufacturing and the other repairing.

Undoubtedly the credit for the initiation of the so-called "straight-line" method belongs to the automotive industry but the railroads can take some credit for the fact that they have studied these methods and have been successful in adapting them to the repair shop—a problem much more difficult because of its uncertainties.

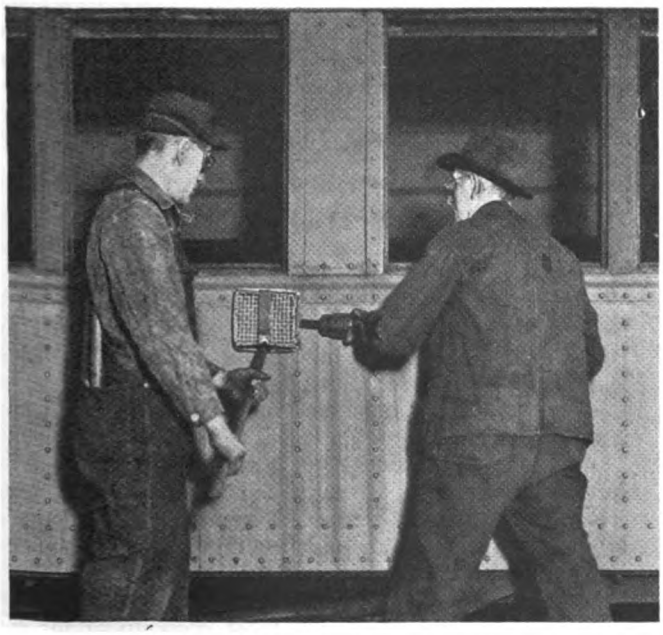
Straight-line methods were first introduced into the railroad field in freight car building and repair work. In spite of initial opposition the system proved its worth in the car department and then was expanded by several roads into the locomotive shop in cases where it could be adapted to a longitudinal shop. Now two roads have bent the straight line a little and applied the system to transverse shops. From observation of these two installations there are many indications that an interesting experiment may develop into a forward step in a new direction.

With the Car Foremen and Inspectors

Rivet-Head Catcher

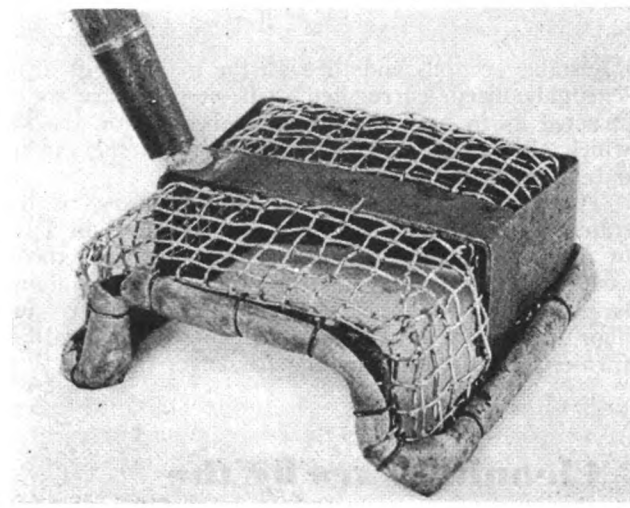
A RIVET-HEAD catcher, designed and made at the Milwaukee (Wis.) passenger-car shops of the Chicago, Milwaukee, St. Paul & Pacific, is now used instead of a broom, etc., to prevent rivet heads from flying when being cut off from the steel plates of passenger cars. This rivet-head catcher possesses several advantages: (1) The device stops the rivet heads at all times. With brooms, the bristles in time are cut off and rivets sometimes go through them. In an experiment the heads from ½-in. rivets were caught and held in the trap until 36 had accumulated without one escaping. The rivet-head catcher is, therefore, a safety device. (2) The device gives clear vision to both the rivet-buster operator and his helper who holds the catcher. It is impossible to see a rivet below a broom. By being able to see the rivet head, the gun operator will not hit the corner of it, or miss hitting it entirely as is often done when a broom is used. The device, therefore, speeds up production. (3) It is estimated that rivet choppers formerly used at least one new broom per week which costs 37½ cents. The rivet-head catcher, being sturdily built at a small cost, will last for a considerable time. The device, therefore, is economical and a money-saver.

The device consists of a wire trap and a wooden handle. the trap is 8 in. long by 8 in. high, and is made of 2 by 2 No. 11 wire. The bottom frame consists of a 5/16-in. common iron rod. The bottom of the trap is entirely open so that it can be placed over the rivet heads that are to be chopped off. At one end of the trap, there is an opening 5 in. wide by 2 in. deep, through which the rivet buster can be inserted. The other end of the trap is reinforced by a 2¼-in. No. 14 iron shield which extends half way around the sides of the trap for the purpose of preventing the wire from being bulged when hit by chopped-off rivet heads. One of the illustrations shows that a large part of the trap consists only of wire, thus affording a clear vision of the rivets being cut off.



Method of using the rivet-head catcher

The wooden handle is screwed onto the trap by means of a ¼-in. by 3-in. lag screw, the head of which is welded onto a No. 10 iron strap which extends over the top of the trap, and is welded onto the bottom frame rod. The wooden handle is 1 in. in diameter by 36 in. long, with a ferrule on the bottom. The handle is set so that it stands at an angle of about 45 deg. to the car surface,



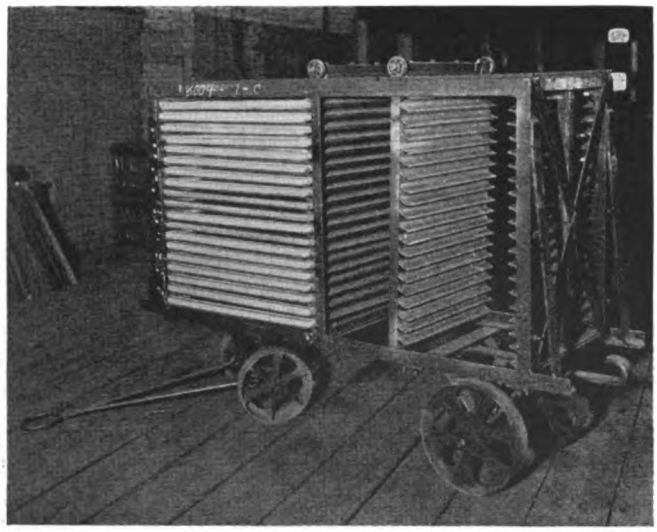
A convenient and efficient rivet-head catcher

thus permitting the helper who holds the rivet-head catcher to keep out of the way of the rivet-buster operator and affording him freedom to work, and plenty of light.

The bottom edges of the trap are covered by rubber so that rivets can be removed when desired without the catcher scratching the paint and varnish on the steel sheets. The rubber is ½-in. white tubing, cut open at the center and cut at 45-deg angles at the corners for snug fits. The rubber is wired onto the bottom frame, the wire being drawn tight so that it is slightly embedded into the rubber.

Sash Buggy

IN order to handle passenger-car sash through the shops in an efficient manner, a number of sash buggies have been constructed and installed at the Chicago car shops of the Chicago & North Western, as shown in the illustration. Each buggy has a capacity to hold one complete set of car sash, the two center sections being adjustable to the various widths necessary. These adjustable sections, which are supported on ball-bearing rolls resting on the top of the welded angle-iron framework, are locked in any desired location by ¼-in. rods which pass through holes drilled in the frames of the



Adjustable buggy which saves labor in handling passenger-car sash

adjustable sections and through the main buggy frame. The galvanized, corrugated sash supports are so constructed as to have the minimum bearing on the sash, which allows the sash to be delivered to the car with only a small marked surface.

The buggies are equipped with drawbars, as illustrated, so that several buggies can be pulled in a train by the shop tractor. The use of these buggies expedites sash movement and avoids the necessity of maintaining large stationary racks in the car paint shop, thus saving floor space, as well as greatly reducing the manual labor formerly required in handling passenger-car sash.

Cleaning Cars by the Scrubbing Method*

By C. S. Tompkins

OF all the methods of cleaning box and refrigerator cars, scrubbing is the most efficient and economical. The equipment needed is simple and inexpensive and the material and labor costs per car are low. In cleaning car floors, it is found that some oils are much more penetrating than others, depending, of course, on viscosity and gravity. A light paraffin oil is much more penetrating than a heavy cylinder oil, and, therefore, the cylinder oil is more easily removed.

In the case of materials such as hides, fertilizer, cabbage, fish, etc., which not only soil but produce odors of decomposition, the scrubbing method mechanically removes refuse matter, and the chemical action destroys the bacteria.

The Materials To Be Used

In selecting the materials to be used, there are but five alkalies that will function, caustic soda, soda ash, silicates of soda, tri-sodium phosphate and bicarbonate of soda. These may be used singly or two or more in combination. Caustic soda, when used alone, has proved injurious to the wood in floors in that it takes the life out of the wood, raises the grain and leaves a reddish tinge. It also is a hazard because of the burns so often suffered by the workmen. It is not the purpose of this paper to recommend any one alkali or any combination of alkalies sold under a trade name, but rather to explain a method for you to select the best yourself. The test that will prove this is simple and does not require the service of a chemist or technical training.

Suppose you want to find out the comparative emulsifying value of caustic soda and soda ash, or of caustic soda and some combination of alkalies, the method of testing comparatively is this: Make up a pint of each of the solutions to be tested at the same strength—say 6 ounces per gal. Heat them both to the same temperature, about 200 deg. F. Prepare some small pieces of metal about one in. sq., or take some iron washers and attach wires to them so that they may be hung in the solution. First dip these pieces into some mineral oil such as oil of petrolatum, cylinder oil, quenching oil, paraffin oil. Allow the two pieces to drain off and then place one in each of the solutions you have made and allow to remain for one minute. Remove and rinse in cold water. If the oil has been removed in the one minute the water will flow over the surface of the metal without a break, but if the oil has not been removed, the water will break over the oil not removed. If the two solutions both clean the metal, then add the same amount of oil to each solution, for instance two cubic centimeters, or five drops. Repeat the cleaning operation by dipping two more pieces of metal into the oil and then placing them in the cleaning solution for one minute and rinsing in cold water to determine if they are clean. Add more oil to each solution, the same amount to each. Continue to repeat the operations until one of the solutions fails to clean. Continue with the one that does clean until it fails, and the difference will be the comparative emulsification value. Suppose that one stops cleaning after twenty drops of oil have been added to the solution, and the other one stops at eighty drops. The emulsifying value of the latter is four times as great as the former.

Or suppose that when you start the test, one cleans and the other one doesn't. You have a pint of each solution at six ounces per gal. Add a pint of water to the one that does clean which will reduce it to three ounces per gal. Try it out at this strength and if it cleans, add another pint of water which will reduce it to two ounces per gal. Try it at this strength and if it cleans, you will know that it will do three times the work of the one that failed. Of course, the temperature should always be the same, about 200 deg. F. in all the tests. The idea is to determine which alkali or combination of alkalies will do the most cleaning at the lowest cost.

Equipment To Be Used in Applying the Materials

The equipment consists of a brush with handle, squeegee, sprinkling can, hose, hook for cleaning cracks, water pail, corn broom and spot hose nozzle.

Either a fibre or wire brush is used. If fibre, it should be of African Bass Fibre such as is used in street brooms. The fibre is stapled in a wooden block about 16 in. by 3¼ in. and gives a scrubbing surface of 18 in. by 5½ in. Two holes in the block provide for handle set at a 45 deg. angle. The wire brushes come in about the same sizes but care should be used in selecting the kind of wire. If the wire is too small in gage and not properly tempered, it catches in the cracks and splinters in the floor and becomes bent, thereby decreasing the scrubbing area of the brush.

A steel frame floor squeegee, with a provision for replacement of rubbers, is the most economical for removing excess water from the floor after rinsing. The

* This article is a part of a general treatise on box- and refrigerator-car cleaning prepared by C. S. Tompkins, a representative of the industrial department of the J. B. Ford Company, Wyandotte, Mich. The study presents facts developed as a result of several years' intensive experience with practical freight-car cleaning operations and methods.

steel back is rigid so that by turning it over, it becomes a scraper. Rubbers should be about 2½ in. wide and 5/16 in. thick and come in lengths from 15 in. to 36 in. The frame is equipped to hold a 4½ ft. handle set at an angle of about 45 deg. These squeegees are better and last much longer than where the rubber is mounted in wood.

A common garden variety of sprinkling can should be used to apply the cleaning solution—three to five gallon capacity. Holes in the spout should be enlarged to about ⅛ in. to allow a free flow of solution and prevent clogging.

The hose is for rinsing out the car after scrubbing with water under pressure. The water may be piped along the cleaning tracks with openings for hose connections about every 40 ft. This allows for 100 ft. of hose to reach six cars without changing connections and reduces dead time.

A small hook is used, about 6 in. long with a round handle to fit the index finger or palm of the hand to prevent hook from slipping when the hands are wet, with the end having a ¼-in. offset flattened to 1/16 in. in thickness which is ideal for removing deposits of dirt from all cracks. It also may be made after the fashion of a long stove poker so that the worker may use it standing up.

A common heavy corn broom can be used for the removal of all loose dirt and refuse from the car. The hose nozzle should be the type with one handle that will permit turning the water on or off with one turn.

While not absolutely necessary, better and quicker results can be obtained when hot water is used to make the cleaning solution and for rinsing cars after cleaning. If hot water is not available, it is not difficult or expensive to secure it.

Some roads use old oil drums with the heads removed to heat water for the cleaning solution. These drums are placed every five or six car lengths along the cleaning track and are raised on a few bricks or old angle irons to permit space for a fire underneath. Old lumber from the repair track is frequently used for fuel. An old piece of sheet iron may be set up on the side to act as a wind shield. Often steel tanks of 50- to 100-gal. capacity are supported on legs leaving sufficient space for a fire underneath. Where steam is available a line may be run to an old oil drum and a pipe with open end can be used to heat the water.

The most efficient method of heating water where car cleaning is done on a large scale is to have a hot water circulating system. In such systems water is heated in a tank and conveyed in an insulated pipe along the cleaning track. Hose connections are placed at intervals along the insulated pipe and hot water at about 200 deg. F. is available in each car. This system was described fully in an illustrated article in the May, 1932, issue of *Railway Mechanical Engineer.*

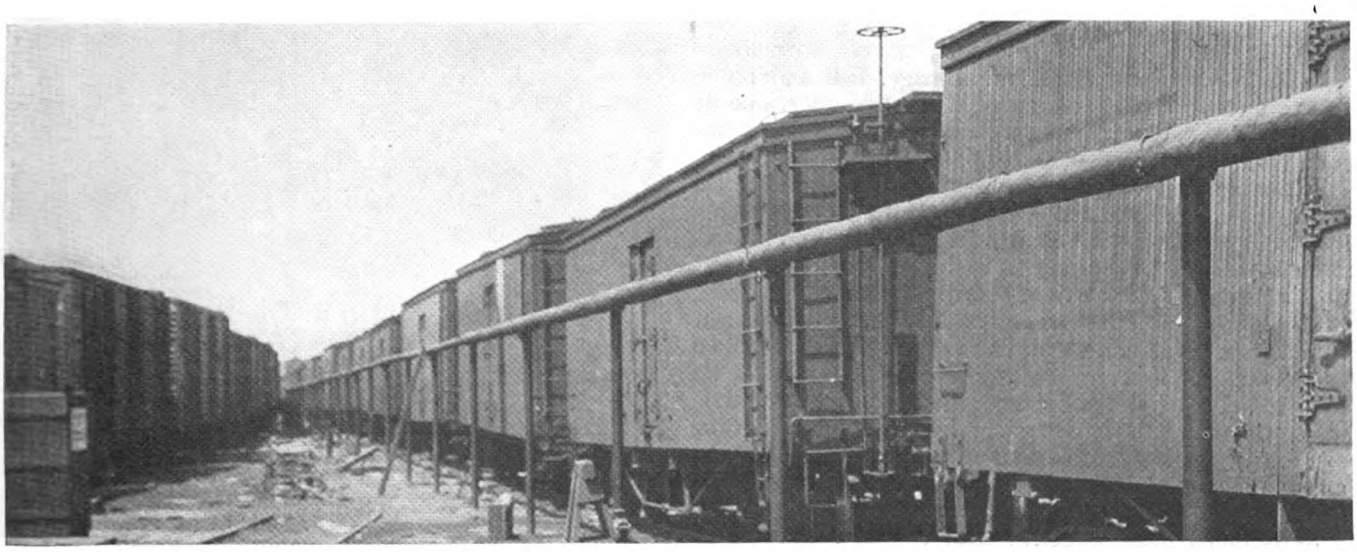
Method of Cleaning Dirty as well as Oily Floors

First, all loose dirt and rubbish should be swept out and nails and cleats removed. The hot cleaning solution should be placed in the sprinkling can and sprinkled evenly all over the floor to be cleaned. The workmen should then remove the accumulation of grain dirt and dust from all cracks and crevices thoroughly, using the hook. In this manner the cleaning solution is allowed to penetrate into these recesses and also to wet the dust and dirt so that if there are any grain weevils or insects in these corners, the cleaning solution will kill them at once. Another method of cleaning out dirt and dust from cracks and crevices is to attach a hose to the air line and with a small opening in the nozzle blow out before wetting the floor with the cleaning solution. However, some places will be found where the dust has hardened into the cracks so that the air won't release it, so as a rule the first method is better.

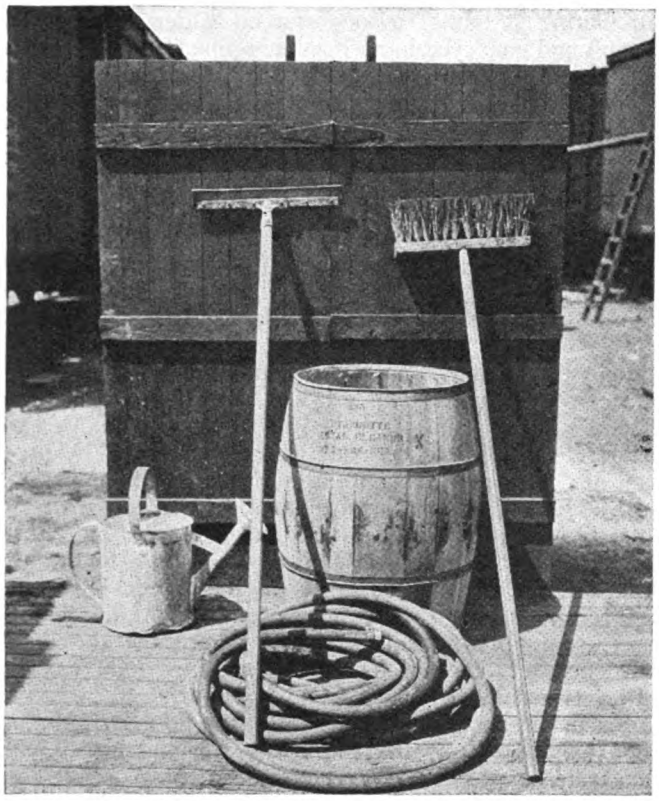
Scrub the floor, first crosswise of the floor boards and then lengthwise so that the bristles of the brush will penetrate between the cracks on the last time over. The amount of cleaner required and the time used in scrubbing depend, of course, upon the condition of the floor. In extremely oily cases, it is sometimes necessary to scrub twice. Conditions are sometimes so bad that it is necessary to cover the floor with the cleaning solution, then sprinkle sawdust about an inch thick over all the floor, wet this with the hot cleaning solution to about the consistency of mush and allow it to remain overnight, then scrub out in the usual way.

Rinse with water under pressure until the water runs clear, after which floor should be squeegeed to remove excess water so that the floor will dry quickly.

Roads using this method have found it difficult to state any positive strength of solution for all cleaning, but in the course of time this works itself out and car cleaners can almost at a first glance of car floor judge about what amount of cleaner is required to do the work economically.



The overhead insulated pipe line through which hot water is delivered to cars being scrubbed



The scrubbing equipment, including water hose and nozzle, scrubbing brush, sprinkling can, rubber squeegee and barrel containing the cleaning agent

If the floor is very oily and especially if the oil is of a thin nature that will penetrate deep into the wood, and you are skeptical as to whether the oil will show up again, a simple test is to heat some sand in the blacksmith's forge or in any other convenient manner, place the sand in a clean bag and lay it over the oil spot cleaned. Allow the bag to remain an hour or so and if there is oil left in the wood, it will show up on the sack. Or a common electric iron, heated and placed on a piece of blotting paper laid on the spot, will show up any oil left in the wood.

I might mention that in rinsing the car the sides and top should be rinsed also to remove any lime, grain or cement dust and insure a good clean and dustless car.

Deodorizing

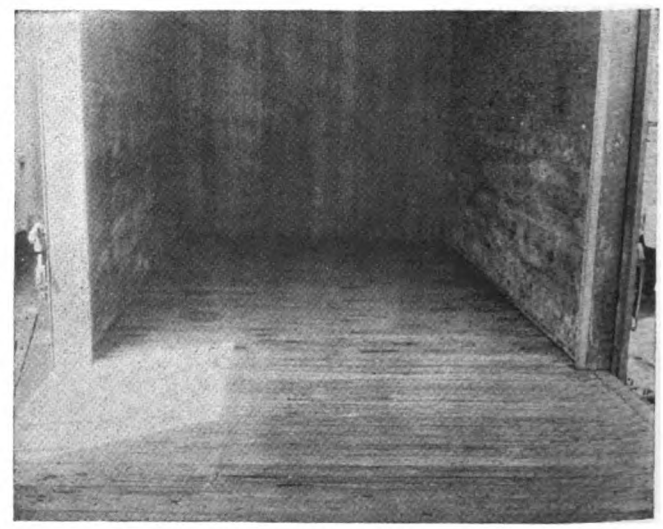
In cases of hides, fertilizer, cabbage, fish and other soiling agents which leave an objectionable odor, one of the most important things in cleaning is to dig out between the cracks in the flooring and corners where any refuse may lodge so that the cleaning solution will have an opportunity to do its work. It is sometimes necessary after the first scrubbing to inspect these cracks and corners, and if they are not clean, to scrub a second time or even the third time before all the soiling agent is removed. In most instances if the car is cleaned thoroughly, there will be no necessity of using any other deodorant, but if there is still any odor, care should be used in selecting a deodorizer not to use a counter irritant. By that I mean one which has an odor of its own so strong that it predominates over the one we seek to eliminate. One of the most efficient deodorizers found so far is one with a content of chloramine gas available. This is much more effective than common chloride of lime or hypochloride gas, for the reason that in the former it may be used hot up to 180 deg. F. without losing its power whereas in the latter, if used hot, the gas escapes from the solution. The chloramine agent is a good sterilizer also and will not oxidize metal while the hypochloride is a fast oxidizing agent.

Weevils

During the past year or so we have had to face the problem of getting rid of weevils caused by the shipping of corn and other grain that has been in storage for some time. Nine out of ten cars loaded with stored grain are infested with these bugs. We have experimented with gases of different kinds and have attempted to seal the cars by pasting paper over the doors and cracks. Sometimes, after leaving the car for a period of 12 hours and over, we have opened it up and found the bugs still there as lively as ever. The best method found to exterminate them is the use of a strong alkali, preferably a fusion of caustic soda and soda ash which makes a more active agent than straight caustic soda. This should be made up about 10 or 12 ounces per gal. and used as hot as possible. After the car has been scrubbed out as previously described, rinsed thoroughly, and the excess water squeegeed out, apply the hot alkaline solution. If corner cleats with three-quarter round or three-cornered are found in the ends of the car, they should be removed before scrubbing as these weevils are sometimes *hiding* there.

A good method of applying the hot alkaline solution is to use a 4- or 5-gal. capacity compressed-air sprayer equipped with a heavy carrying strap after the fashion of some fire extinguishers. The nozzle is equipped with a thumb valve and should be set to allow a stream about the size of a pencil lead. With the sprayer carried by the strap over the shoulder the operator directs this small stream into the cracks around the edges of the floors and sills. Car should then be allowed to dry without rinsing.

Many shippers of grain and food products are inspecting cars closely now, and if one of these bugs is found, the car is rejected. These inspections are conducted with a flashlight. The inspectors dig into every crack and bring out the accumulated dirt and dust in their hunt for bugs, so I repeat that one corner or crack missed in the cleaning operation may mean a rejected car and added switching charges.



Interior of double-sheathed box car after being thoroughly cleaned by the scrubbing method

Bugs of the weevil family are protected by a chitin or coating which is composed of a substance called glu-

coamine with calcium carbonate as the hardening agent. The body of the bug is divided into six segments, each of which is a respiratory tract. The action of the alkali in killing them is a chemical action in that it reduces this chitin or coating to a gelatinous substance and in so doing closes the pores in these respiratory tracts and actually smothers the bug. They do not come to life again, either. We have had some interesting experiences with them. We would try out a method of ridding a car of them and think we had accomplished our purpose only to find that the darned things were only playing possum and in a short time would come to life again.

The hotter the solution used to exterminate, the better, as a temperature of over 150 deg. F. is fatal. I might add that gas is very effective in exterminating pests such as cockroaches, bedbugs, water bugs, etc., but is a failure on weevils. One thing, of course, is evident about box cars—it is almost impossible to seal them air tight. However, in fumigating work cars, they can be sealed tight enough to rid them of bugs of the cockroach family.

Double-sheathed cars, when infested with weevils, are much more difficult to clean than single-sheathed cars. In treating cars the most important thing is to clean out the cracks and crevices of all accumulations of grain, dust and dirt, one corner or crevice not dug out may mean the rejection of the car for food products.

Now for a report on the cost of cleaning oily and greasy cars by the scrubbing method. This report covers a period of six months for cleaning 2,950 cars on one railroad, taking into consideration the complete cost per car. Of the total number of cars washed 20 per cent were carded to the repair track for cleaning, no other repairs being needed. All cars had the entire floors covered with various vegetable and mineral oils, they having been loaded with hides, fleshings, fertilizer, cement, lime, etc., which condemned the cars for high class ladings.

A careful analysis of all elements of cost, over a six-months period, shows an average of $.9229 per car. This cost does not cover cars that were just swept out or cars that were simply rinsed out with water, but cars in which the floors were covered with grease, oil or other soiling agents as noted.

Refrigerator Cars

The general run of refrigerator cars usually require cleaning after each trip in order to insure a clean and odorless car. Cleaning mixtures are made according to the condition of the car, and are best known by those who handle this work daily. The general practice when opening doors is to remove all rubbish on top of the floor racks and sweep them clean. Then lift the racks into position and lock. Examine the ice pan racks to see that they are open, and proceed, sweeping the ice bunker and ice pan clean of all cinders, etc. Then sweep the floor. The cleaning solution is then sprinkled over the floor and on the ice pan when dirty conditions exist. Otherwise, after sweeping out the car, the floor racks are dropped and the cleaning solution sprinkled on the floor racks, floor and ice pans. The floor racks are then scrubbed and flushed off with a small amount of water, after which they are lifted into position and locked. The floor and ice pans are then scrubbed, flushed and sqeegeed out. This procedure, of course, varies according to the condition of the car. A test made on a refrigerator car loaded with cabbage in a decayed condition showed a cost of cleaning as follows: Cleaner, .30; labor, .56; water, .01; electric energy, .03; overhead, .27; total cost, $1.17. This was an exceptionally dirty car. However, the cost on other cars which are the average run between 30 cents and 62 cents per car.

The intent of this paper, as before stated, has not been to advertise any product nor to criticize any method or materials used, but to give you the writer's experience and to get the subject before you so that by discussion and constructive thought the problem of furnishing a clean car to the shipper who rightfully demands one may be met at the least cost and with the greatest despatch.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Deposit of Mud in Tank Car after Test

The Great Northern tested a tank car belonging to the North American Car Corporation at their Great Falls shop and then returned it to the White Eagle Oil Corporation who found it necessary to steam tank and clean the interior with kerosene account of dirt and mud alleged to have been left in the tank when tested by the Great Northern. In addition to the White Eagle Oil Corporation repair card, joint inspection was secured showing that two inches of mud had been left in the bottom of the car. The North American Car Corporation claimed the Great Northern should assume responsibility for cleaning and deposit of mud. The Great Northern claimed that they used filtered water when tank was tested and no mud was present at that time. Failing to agree, the matter was referred to the Arbitration Committee. The North American Car Corporation contended that the car referred to was not loaded between the time it was tested by the G. N. and its receipt by the White Eagle Oil Corporation and that the residue, therefore, could not have got into the tank between the date of test and inspection. For some time prior to the test the car had been running in clean service carrying gasoline; had there been any existing deposit this would have caused the gasoline to go off color, with resultant claim against carrier for loss of value. That no such claim had been made prior to the time that car was tested is clear proof that the mud was carried into the car at the time test was made. Cleaning was necessary before the car could be used for transporting gasoline and, therefore, the G. N. should assume cost of subsequent cleaning, which amounts to $7.58. The G. N. contended that water used to fill the tank for testing was filtered through a sand bed and was the same as used in their stationary and locomotive boilers. Such a deposit of mud it is claimed could not, therefore, have been introduced with the water used for test. During the past year more than 120 tank cars had been given hydrostatic tests at the same point, Great Falls, and no similar deposit had been reported.

In a decision rendered October 26, 1933, the Arbitration Committee said: "The evidence indicates that the responsibility for the deposit of mud in the tank car rests with the Great Northern. Claim of car owners is sustained."—*Case No. 1730, North American Car Corp. vs. Great Northern.*

In the Back Shop and Enginehouse

Engine-Condition Board

A CONVENIENT method of telling at a glance the condition of locomotives assigned to the various operating divisions of the railroad has been devised by W. H. Sagstetter, assistant superintendent of motive power of the Wabash. This is called a condition-of-engines board, and a plan of the one used in the motive-power office of the Wabash is shown. The object of this board is to have a complete and always up-to-date picture of the power situation, readable at a glance and without having to consult the various divisional typewritten statements of engine serviceability.

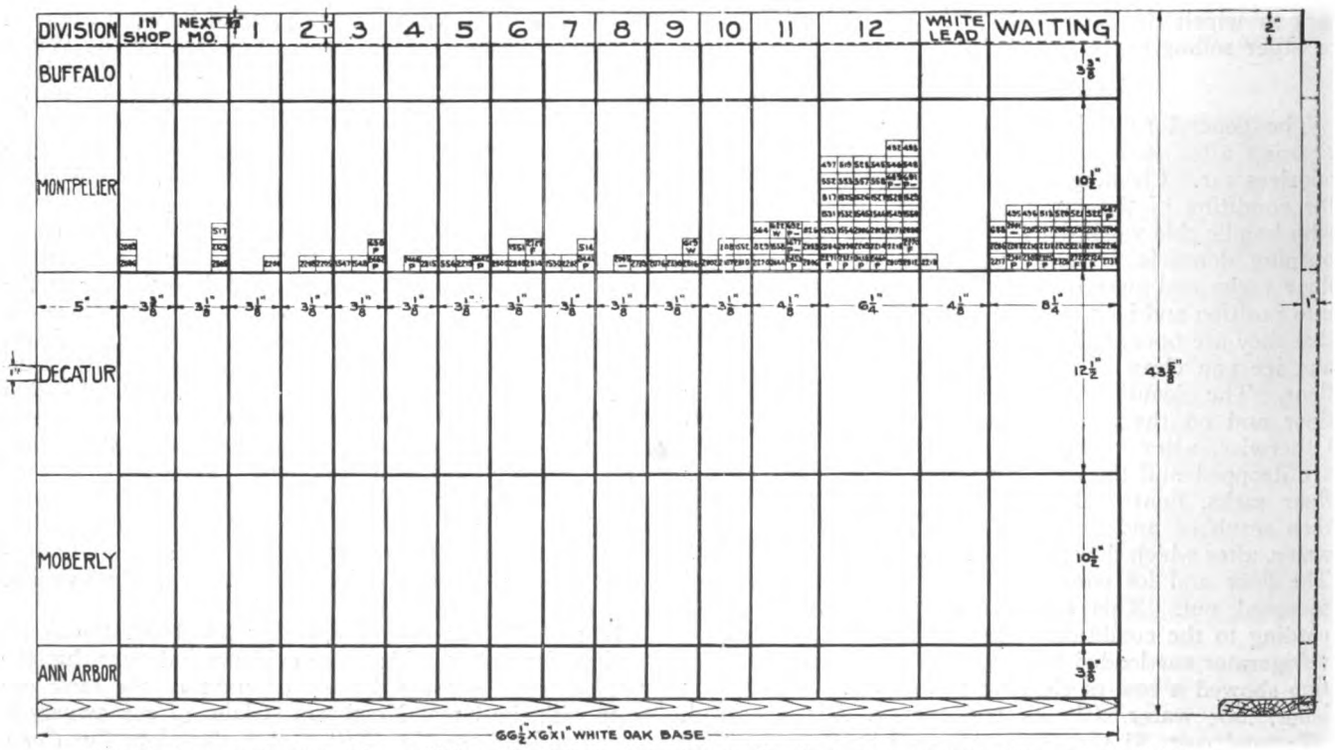
This board can be set on a desk or hung on the wall in the motive-power office, easily accessible to those interested. It is made of No. 16 gage iron with an oak stain finish and has transverse partitions separating the operating divisions, and vertical partitions to provide spaces for the number of months' service remaining in each engine. The first column at the left shows the name of the division, the next column is for engines in the shop during the current month, and the next column is for engines expected to shop in the succeeding month. Then there are spaces for engines good for one month, two months, three months, etc., up to a column for engines with 12 or more months' serviceability. The last two spaces at the right are for white leaded engines and for those waiting shop.

The Wabash board is 66½ in. wide by 43-⅝ in. high, but the board and the width of the divisional spaces can, of course, be made of whatever dimensions are necessary to accommodate blocks for all engines on the railroad. In the illustration, the blocks have been indicated for one division only, whereas, in using the board, every engine owned is represented by its numbered block. Each engine block is a one-inch cube of yellow pine, with each side painted a different color of the following significance: Blue—Class 1 or 2 repairs; red—Class 3 repairs; green—Class 5 repairs; yellow—proposed to dismantle; black—flue extension granted; white—white lead.

The engine number is stenciled in ⅜-in. white figures on each side, except the white side, where black figures are used. Under the engine number is stenciled letters indicating various pertinent information concerning that particular engine. At present, the following symbols are being used: B—booster; F—feedwater heater; P—power-reverse gear; W—Walschaert valve gear;—heavy frames; S—superheater.

A small No. 16 gage iron "key" shows for ready reference the various engine block markings. These markings are made use of usually in connection with an improvement program for one or several classes of engines, and the scheme permits of showing any desired special information concerning any engine.

The method of manipulating the blocks is simple. Once a month, after the master mechanics have had their condition-of-engines conferences and reported the months' serviceability in each of the locomotives assigned



Detailed arrangement of condition-of-engines board used in the motive-power office of the Wabash

to their divisions, the locomotive record clerk places each engine block in the proper month, whitelead, or waiting shop, vertical space. Then the assistant superintendent of motive power places in the "In Shop" space the blocks for the engines expected to receive classified repairs during the current month, and in the "Next Month" column the engines that will probably receive classified repairs in the succeeding month. When an "In Shop" engine leaves the shop, it is not placed in the 12-month or whitelead space at once, but is placed on the right side of the "In Shop" space and remains until the end of the month. Similarly, when a "Next Month" engine enters shop before the end of the month, the block is placed to the left side of the "Next Month" space until the end of the month.

Swing Gates for Drop-Pit Tables

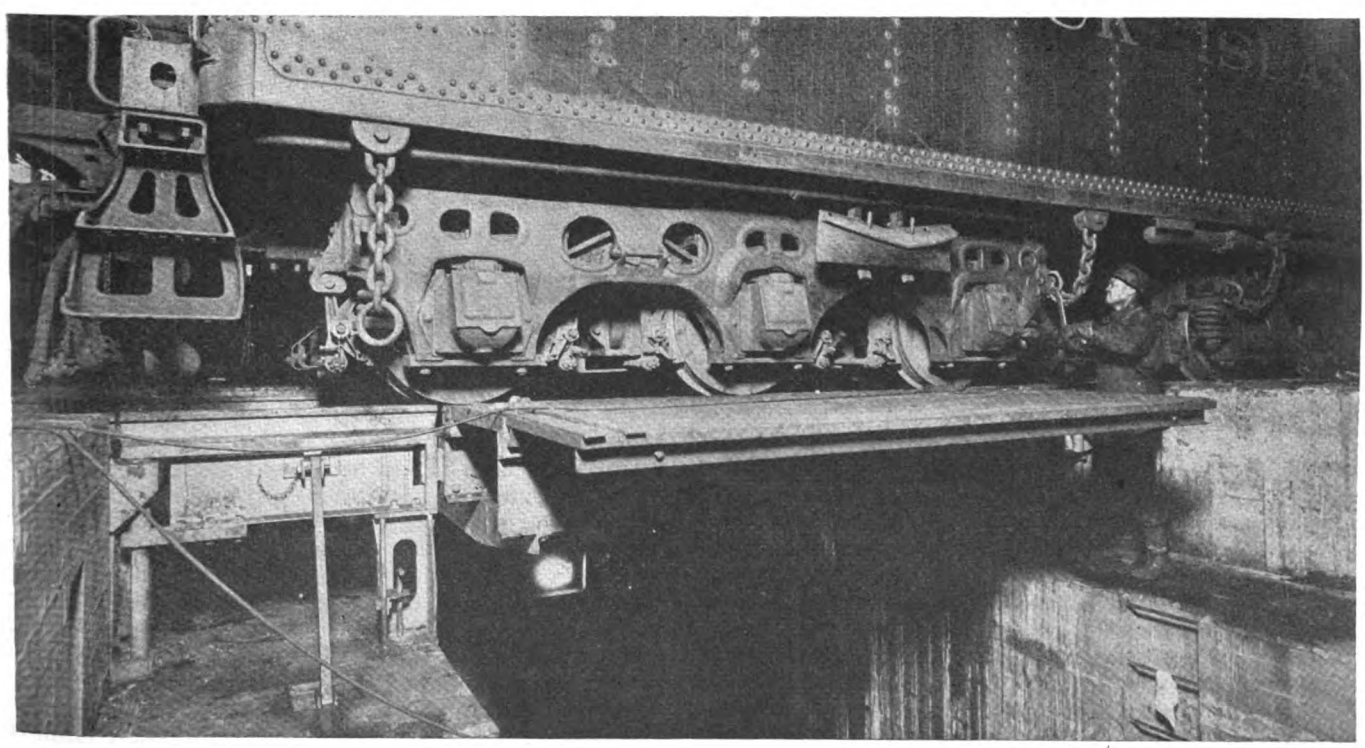
DROP-PIT table platform tops rarely have a dimension across the drop pits greater than 11 ft. since, if this distance is increased, certain classes of locomotives will have more than tow pairs of driving wheels resting on these tops at one time. With three pairs of such wheels on a drop-pit table top, capacities must be increased, which in turn increase the price of the entire installation. The greatest objection, however, to table tops longer than 11 ft. is the problem confronted in dropping single pairs of rear or front driving wheels under switch engines where rear or front ends must be temporarily supported on areas beyond the drop pit. Furthermore, some roads do not care to have two pairs of driving wheels supported on grease cellars while another pair is being dropped.

The modern locomotive has introduced new problems in that it is frequently necessary to drop complete six-wheel tender trucks and two- or four-wheel trailer trucks, with or without boosters, at minimum expense. In order that this work may be performed on a table top of the usual length, with the knowledge that this length is sufficient for the wheel bases of these trucks, but insufficient for the overall length of interfering truck parts, the Whiting Corporation originated its self-supporting swing gates, pivoted to the side walls of single or double shoulder pits. Through their addition, it is now possible to drop, on a standard drop-pit table, two pairs of large driving wheels, a complete six-wheel tender truck or a four-wheel trailer truck with booster, even though the last-mentioned truck has an overall dimension of 21 ft.

The view accompanying the article shows a Whiting drop pit equipped with a shoulder pit on each of its side walls. The shoulder pits are approximately 40 in. deep and 5 ft. wide. The swing gates in these shoulder pits are locked in "Out" position. Each of the table top's four locking bars is locked into the end recess of each gate. The drop-pit table, itself, has been racked to another stall.

It will be noted that the table top and four swing gates are supporting the entire six-wheel tender truck and its load. All three pairs of truck wheels are on the table top and the truck frame protrudes beyond the ends of the top. Note that the outside end of the gate in the foreground has a supporting bracket resting on a metal plate, which is flanged at its inside edge in order to keep its rail in alinement. Also note the protective pivoted brace, and the gate lock located near the base of the supporting bracket of the gate.

To release the truck, it is necessary only to bring the jack portion of the drop-pit table under its top and raise the latter slightly for the release of its four locking bars. The gate braces are disconnected and swung into their floor recesses, gates unlocked and swung against the side walls of the shoulder pits. The table top with its load now is lowered sufficiently to clear the tender, racked sidewise and raised to ground level between stalls for release across a shoulder pit on special rails resting on



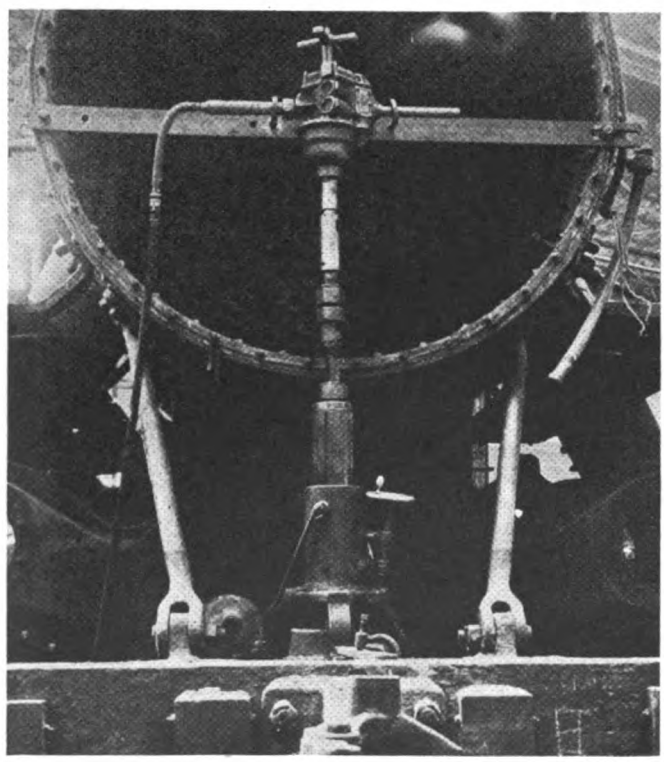
Dropping a six-wheel tender truck on a Whiting drop-pit table equipped with two swing gates

the pit wall and on two of the locking bars. If release is to be made on a stall track, the racking movement to this stall is continued after the table top is raised to ground level.

Shoulder pits and gates need be applied to only one of the several pits served by the drop pit. They may be applied to old installations, and with moderate expense the railroads can modernize their installation, whereby it will be possible to handle two pairs of large driving wheels at one time, or complete six-wheel tender trucks and two- and four-wheel trailer trucks.

Truing Worn King-Pin Holes

THE use of an air motor-driven boring bar, especially adapted for truing worn king-pin holes in locomotive front-deck castings, is shown in the illustration. The device consists of a boring bar, clamped to the deck casting, as shown, and provided with a three-jaw tool holder, with spindle extension to the compound air motor, suitably supported on a crossbar bolted to the smoke-box front end. Hand feed of the spindle and cutting tool is provided by means of the small hand



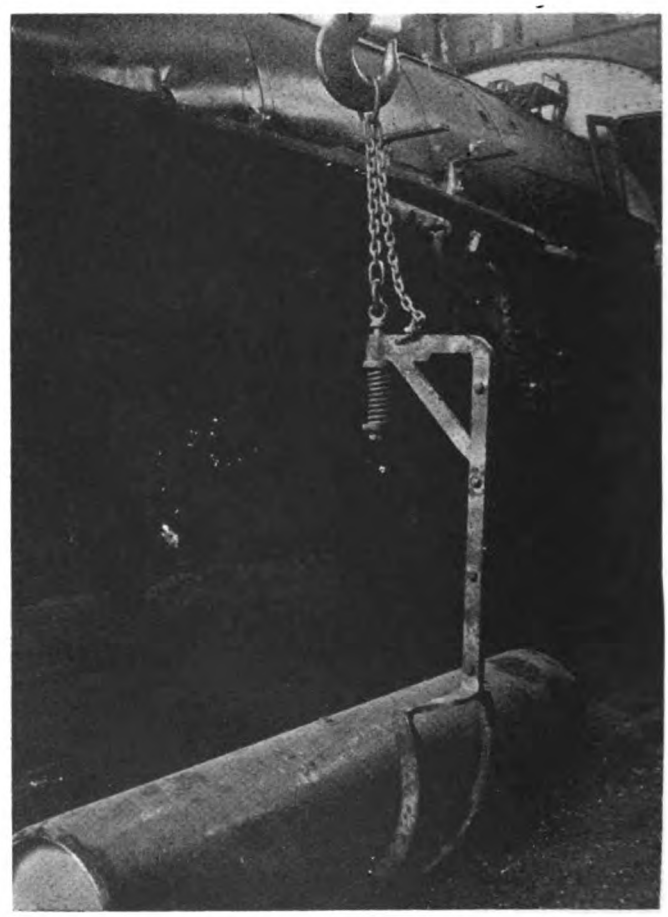
Boring bar as used to true the worn king-pin hole in a front deck casting

wheel, shown, and the tool bits also are hand adjusted and held by set screws to bore the proper size hole.

One or two cuts are usually necessary, depending upon the wear, and the hole can then be bushed to bring it back to the standard size. In case of subsequent wear, it is only necessary to renew the bushing. The use of a boring bar in this connection is a great time- and labor-saver, since, otherwise, the deck casting would have to be removed in order to perform the machine operation on a stationary machine tool. Subsequent delay and labor cost in reapplying the casting would also be necessitated.

Applying Air Reservoirs

THE crane attachment illustrated has proved very satisfactory for applying and removing main air reservoirs at the Chicago shops of the Chicago & North Western. It consists of a bolted double-bar structure, forged to a right-angle bend at the upper end to provide



Main reservoir lifting device used at the Chicago shops of the C. & N. W.

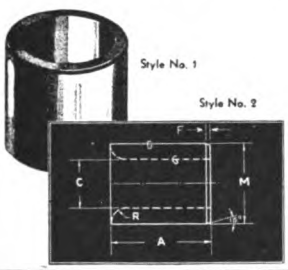
the offset attachment to the supporting chain from the shop crane, and having half-round hooks at the lower end to extend underneath the reservoir and support it in a horizontal position during the lifting operation. The offset construction of this device permits lifting the air reservoir against the blocks underneath the running board, which could not be done with a direct chain or cable attachment from the crane hook to the reservoir. To provide against the possibility of straining the device or bending the running-board brackets, in case the lifting motion of the crane is not stopped quite quickly enough, the lifting I-bolt is spring supported. A safety chain is also provided, as illustrated, as an additional precaution against failure of the lifting device.

Railroad Pins And Bushings

FOR many years, the pins and bushings used in locomotive driver brake and spring rigging, passenger-car and tender-truck brakes, have presented an important problem. Originally, the hangers, equalizers, rods, frames, etc., were equipped with a type of pin and bushing which developed wear rapidly and, therefore, had a relatively short service life. Most of the railroads made these parts in their own shops and, due to the lack of adequate manufacturing facilities, they were unable to handle the necessary machining, heat-treatment and grinding operations with the desired degree of accuracy and low unit cost. Tolerances were not held, holes not reamed accurately, and not enough importance was attached to the quality of the material used. As a result wear was rapid, necessitating frequent repairs or replacement between shoppings, with attendant excessive maintenance cost and interruptions of service.

Recognizing the savings which could be made by the use of pins and bushings of superior certified quality, incorporating the proper hardness, tolerances and performance, representatives of a number of railroads met July 14, 1932, at the Detroit (Mich.) plant of the Ex-Cell-O Aircraft & Tool Corp., to agree upon certain standard-size pins and bushings which could be manufactured in quantities at low unit cost, using the modern

Table 1— Typical Partial Table of Standard Sizes for Ex-Cell-O Hardened and Ground Steel Railroad Bushings



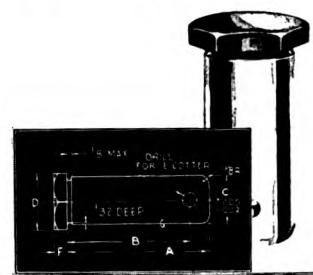
Style No.	Bushing No.	C	M	A	R	Style No.	Bushing No.	C	M	A	R	Style No.	Bushing No.	C	M	A	R
1	2100	1	1 3/8	1		1	2120	1 1/2	1 7/8	1 3/4		1	2195	1 3/4	2 1/2	2 1/2	
1	2129	1 3/8	1 1/2	1/2		1	2148	1 1/2	1 7/8	1		1	2200	1 3/4	2 1/2	3	
1	2142	1 3/8	1 1/2	5/8		1	2152	1 1/2	1 7/8	1 1/4		1	2205	1 3/4	2 1/2	3 1/4	
1	2131	1 3/8	1 1/2	3/4		1	2125	1 1/2	1 7/8	1 1/4		1	2210	1 3/4	2 1/2	3 1/2	
1	2107	1 3/8	1 1/2	1/8		1	2130	1 1/2	1 7/8	1 1/2		1	2215	1 3/4	2 1/2	4	
1	2109	1 3/8	1 1/2	7/8		2	2013	1 1/2	1 7/8	2 1/4	1/4	1	2220	1 3/4	2 1/2	1 3/4	
1	2132	1 3/8	1 1/2	1 1/4		1	2135	1 1/2	2	1 3/4		1	2225	1 3/4	2 1/2	1 1/4	
1	2105	1 3/8	1 1/2	1 1/2		2	2041	1 1/2	1 1/2	3 1/4	1/4	1	2230	1 3/4	2 1/2	1 1/2	
1	2147	1 3/4	1 5/8	5/8		1	2136	1 5/8	2	1 3/8		1	2235	1 3/4	2 1/2	1 5/8	
1	2127	1 3/4	1 5/8	3/4		1	2116	1 5/8	2 1/8	1 7/8		1	2240	1 3/4	2 1/2	2	
1	2114	1 3/4	1 5/8	1		1	2101	1 5/8	2 1/2	2		1	2245	1 3/4	2 1/2	2 1/4	
1	2365	2	2 1/2	1 1/4		1	2455	2 1/4	2 3/4	3 1/4		1	2540	3	3 1/2	4	
1	2370	2	2 1/2	1 1/2		1	2460	2 1/4	2 3/4	3 3/4		1	2545	3	3 1/2	4 1/4	
1	2375	2	2 1/2	1 3/4		1	2465	2 1/4	2 3/4	4		2	2550	3 1/4	3 1/4	4 1/2	H
1	2380	2	2 1/2	2		1	2470	2 1/4	2 3/4	4 3/4		1	2555	3 1/4	3 1/4	2 1/2	
1	2385	2	2 1/2	2 1/4		1	2126	2 1/4	2 1/4	2		1	2560	3 1/4	4 1/4	1 3/4	
1	2390	2	2 1/2	3		1	2121	2 1/4	2 3/4	1 3/4		1	2565	3 1/4	4 1/4	2 1/2	
1	2395	2	2 1/2	3 1/4		1	2471	2 1/2	3	1		1	2570	3 1/2	3 3/4	7 3/4	
1	2400	2	2 1/2	3 1/2		1	2475	2 1/2	3	1 1/2		1	2575	3 3/4	4 1/4	4	
1	2405	2	2 1/2	3 3/4		1	2480	2 1/2	3	1 1/4		1	2580	4	4 3/4	5	
1	2103	2 3/4	2 3/4	1 1/2		1	2485	2 1/2	3	2							
1	2128	2 3/4	2 3/4	2		1	2490	2 1/2	3	2 1/4							
1	2104	2 1/4	2 1/2	2 1/4		1	2495	2 1/2	3	3							

plant and production facilities of this company. Blue prints, furnished by over 30 roads, were studied, and, by the elimination of unnecessary sizes and types, the number of sizes of bushings was reduced from approximately 1,500 to 141 and pin sizes from 1,800 to 173.

The bushings adopted as standard are made from S.A.E. 1010 steel, carburized to a depth of 1/32 in, and hardened to approximately 60 C Rockwell scale, or 610 Brinell equivalent. They are ground smoothly to .002 in. tolerance to remove scores and tool marks and permit assembly with the pins having the proper tolerances. The hard case provides many times the wear of soft steel parts, and the soft core gives toughness to withstand the shocks incident to heavy-duty service. The hard, smooth, ground surfaces do not permit grit to accumulate, but pulverize it and cast it off.

Fairly close tolerances are provided to prevent seizing and to insure proper clearance between the pin and bushing. For example, there is a standard clearance of 1/32 in. and the bushing and pin tolerances are .010 in.; if the pin is on or slightly over the high limit and the bushing is on or slightly under the low limit, seizing may result.

Table 2—Partial Table of Sizes for Ex-Cell-O Hardened And Ground Railroad Pins



Pin No.	C	B	A	D	E	F
5000	1 1/8	1 1/2	5	1 1/2	1/2	3/8
5001	1 1/8	2 1/2	3	1 1/2	3/8	3/8
5002	1 1/8	3	3 1/2	1 1/2	3/8	3/8
5003	1 1/8	3 1/2	4	1 1/2	3/8	3/8
5004	1 1/8	3 3/4	4 1/4	1 1/2	3/8	3/8
5005	1 1/8	4 1/8	4 5/8	1 1/2	3/8	3/8
5006	1 1/8	4 1/2	5	1 1/2	3/8	3/8
5007	1 1/8	4 7/8	5 3/8	1 1/2	3/8	3/8
5008	1 1/8	5 1/4	5 3/4	1 1/2	3/8	3/8
5062	1 1/8	5 1/4	5 3/4	2 3/8	1/2	3/8
5063	1 1/8	5 1/2	6 1/4	2 3/8	1/2	3/8
5061	1 1/8	5 7/8	6 3/8	2 3/8	1/2	3/8
5065	1 1/8	6 1/4	6 7/8	2 3/8	1/2	3/8
5066	1 1/8	6 1/2	6 7/8	2 3/8	1/2	3/8
5067	1 1/8	6 1/2	7 1/4	2 3/8	1/2	3/8
5068	1 1/8	6 1/2	7 1/4	2 3/8	1/2	3/8
5069	1 1/8	7 1/8	7 3/4	2 3/8	1/2	3/8
5070	1 1/8	7 3/8	8 1/4	2 3/8	1/2	3/8
5071	1 1/8	7 3/4	8 1/4	2 3/8	1/2	3/8
5072	1 1/8	7 1/2	8 5/8	2 3/8	1/2	3/8
5520	1 1/8	1 3/8	1 1/2	1 7/8	3/8	3/8
5501	1 1/8	1 7/8	3 1/4	1 7/8	3/8	3/8
5519	1 1/8	1 3/4	3 1/4	1 3/8	3/8	3/8
5505	1 1/8	3	3 1/4	1 3/8	3/8	3/8
5524	1 1/8	5 3/4	6 1/4	1 7/8	3/8	3/8
5503	1 1/8	6 1/4	6 3/4	1 7/8	3/8	3/8
5511	1 1/8	2 3/8	3 1/4	1 3/8	3/8	3/8
5016	1 1/8	2 1/2	3 3/8	1 3/8	3/8	3/8
5515	1 1/8	3 1/4	3 3/8	1 3/8	3/8	3/8
5081	1 1/8	10 1/4	10 7/8	2 3/8	1/2	3/8
5086	2 1/8	3 1/4	7 3/8	2 7/8	1/2	3/8
5087	2 1/8	3 3/8	8 1/4	2 7/8	1/2	3/8
5088	2 1/8	4 1/2	4 3/4	2 3/8	1/2	3/8
5089	2 1/8	5 1/2	5 3/4	2 7/8	1/2	3/8
5090	2 1/8	5 3/4	6 3/8	2 7/8	1/2	3/8
5091	2 1/8	6	6 3/8	2 7/8	1/2	3/8
5092	2 1/8	6 1/4	6 7/8	2 7/8	1/2	3/8
5093	2 1/8	6 1/4	7 1/4	2 7/8	1/2	3/8
5094	2 1/8	6 3/4	7 3/4	2 7/8	1/2	3/8
5095	2 1/8	7 1/4	7 7/8	2 7/8	1/2	3/8
5028	1 1/8	2 1/4	2 3/4	2 1/2	3/8	3/8
5522	1 1/8	3 1/4	3 3/4	2	3/8	3/8
5525	1 1/8	—	5 1/2	—	—	—
5031	1 1/8	3/4	2 1/2	2 3/8	3/8	3/8
5032	1 1/8	1 1/4	5 1/2	2 3/8	3/8	3/8
5033	1 1/8	1 1/4	8 1/4	—	3/8	—
5034	1 1/8	3 1/2	3 3/4	2 3/8	3/8	3/8
5035	1 1/8	3 1/2	4	2 3/8	3/8	3/8
5036	1 1/8	3 7/8	4 3/8	2 3/8	3/8	3/8
5107	2 1/8	8 3/8	9 1/2	3 1/2	1/2	3/8
5108	2 1/8	9 1/2	9 1/2	3 1/2	1/2	3/8
5109	2 1/8	9 7/8	10 1/4	3 1/2	1/2	3/8
5110	2 1/8	9 1/2	10 1/2	3 3/8	1/2	3/8
5111	2 1/8	10 1/2	10 3/4	3 3/8	1/2	3/8
5112	2 1/8	10 7/8	11 1/8	3 3/8	1/2	3/8
5114	3 1/8	10 1/2	11 1/2	4 1/2	1/2	3/8

This is doubly true where the rod or hanger holes are reamed slightly out of line, which is frequently the case. With .002-in. tolerance for both the bushing and pin, there is no possibility of seizing, and, contrary to common belief, it does not increase costs, since the hole-grinding machines operate entirely automatically.

Test applications have been made in a number of railroad shops, car and locomotive brake and spring rigging being equipped with the new Ex-Cell-O products. One of the first installations was on the kitchen end of a dining car, which has since run about 250,000 miles with only approximately .002-in. wear. Soft steel pins and bushings, applied at the same time at the opposite end of the car, showed .001-in. wear at the end of 1,300 miles of service and have since been replaced.

Second and third standardization meetings were held in the fall of 1932 to consider the more difficult problem of pin standardization, with a view to eliminating unnecessary types and sizes. It was brought out clearly that the threaded and slotted pin would cost the railroads considerably more than the plain pin with a cotter, or even the plain pin with a hardened precision washer and plain cotter pin. As a result, the railroads were advised

to eliminate the threaded and the slotted pin and base their standard on the plain pin with a washer. The use of a washer was not considered absolutely necessary but, in many cases, it should be used as a precaution to eliminate the shearing of the cotter pin.

Work continued on the pin standard, and, on July 13 and 14, 1933, the railroad representatives again met in Detroit to consider the finished standard. All varying weights of locomotives had been considered, and the



Battery of grinders equipped with Ex-Cell-O internal grinding spindles for finishing medium and small size holes

entire study was laid before those present. Any hesitancy to depart from the old accustomed practices was dissipated when it was shown by actual shear and bend test reports that the product proposed had a three-to-one safety factor over the 55,000-lb. minimum tensile strength requirement, and the railroad men present agreed that the change-over could be safely made. Thus, the standard was developed over a three-year period with the active co-operation of the railroads and after conference with, and the general approval of, interested committees of the American Railway Association, Mechanical Division.

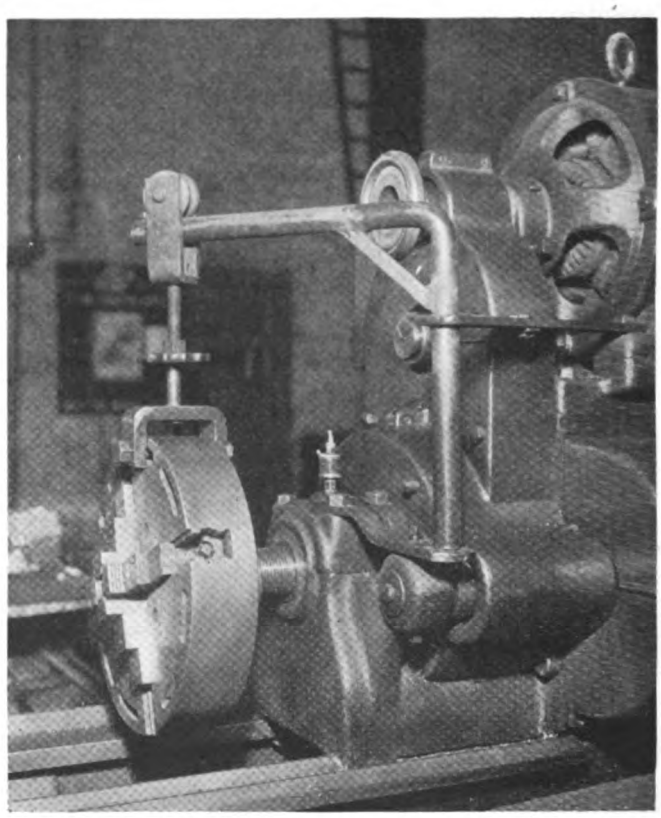
Ex-Cell-O pins and bushings are hardened and ground to tolerances which do not vary. The bushings can be pressed immediately into old hanger holes and stay in service for several hundred thousand miles. When replacement becomes necessary, the old bushings are pressed out and new ones pressed in without building up holes or disturbing the set-up in any way. Tests on one of the railroads are said to have shown that the bushings can be pressed in and out 15 times without destroying the press fit.

Brake performance is better because wear is not sufficient to destroy the even take-up of the original air brake application. The use of bushings for brake-beam ends has effectually eliminated the necessity of building up beam ends by welding in the back shop. By using certified standard bushings and pins, it is no longer necessary to replace hangers, brake heads, rods, etc., as the wear is slight.

Approximately 40 railroads and 12 firms manufacturing products strictly for railroad consumption are said to be now using the Ex-Cell-O products. The standard sizes adopted do not include every pin or bushing used on each individual railroad, which would require many types, involving small lots not conveniently carried in stock. It does, however, cover approximately 90 per cent of all the pin and bushing sizes used by the railroads, which is substantially all that any standard can include. On receipt of a set of detail drawings for locomotives or cars, the Ex-Cell-O Aircraft & Tool Corporation will make a complete check and recommendation of standard sizes which have been found by experience to give satisfactory performance.

Lathe Chuck Carrier

A SIMPLE but effective means for handling chucks which must be frequently applied to and removed from lathe spindles is shown in the illustration. The device consists of a 1⅛-in. round-steel bar bent at right angles and suitably supported on the engine-lathe head in such a way that the horizontal part of the bar which carries a roller and hand-screw support for the chuck can be swiveled so that the chuck may be either swung



Chuck-handling attachment applied to an engine lathe

into line with the engine-lathe spindle or readily pushed around back of the engine-lathe head where it is out of the way. It will be noted that a small, diagonal arm is welded across the corner of the round supporting bar to give it additional stiffness. A stop pin is inserted in the outer end of the horizontal bar to prevent any possibility of the roller support leaving the bar and dropping the chuck. Hand-screw adjustment for height is provided, as shown; also convenient means for quickly attaching the clamp to the top of the chuck.

THE INDIANAPOLIS UNION RAILWAY COMPANY has been awarded the achievement cup by the Smoke Abatement League of Indianapolis, Ind., for making the best record of any railroad in the city in the past year. The line's record was 0.86 per cent violation or 8.6 violations recorded in every 1,000 observations. The Pennsylvania was second with 8.8 violations and the Cleveland, Cincinnati, Chicago & St. Louis, was third.

NEWS

THE NORTHERN PACIFIC has undertaken the construction of extensions to five stalls of its Mississippi Street enginehouse at St. Paul, Minn.

I. C. C. Moving to New Offices

THE BUREAU of Locomotive Inspection, the Bureau of Safety, and the Bureau of Service of the Interstate Commerce Commission have moved their offices to the new Interstate Commerce Commission building at Twelfth street and Constitution avenue, Washington. The general offices of the commission are expected to move shortly.

Equipment on Order

CLASS I RAILROADS on July 1 had 17,813 new freight cars on order, according to reports received by the Car Service Division of the American Railway Association. On the same day last year, 1,205 new freight cars were on order and on the same date two years ago, there were 1,951.

New Equipment

CAR ORDERS

Road	No. of cars	Type of car	Builder
Norfolk Southern	2[1]	Gas-rail motor	A. C. & F.
Uruguayan State Rys.	4	Rail motor	J. G. Brill Co.

CAR INQUIRIES

Ill. Central	1[2]	Rail motor	.....
	1[2]	Bagg.-mail-exp.	.....
	1[2]	Smoker and coach	.....
	1[2]	Coach	.....
	1[2]	Cafe-lounge	.....
	1[2]	Parlor-observ.	.....

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of locomotive	Builder
Pennsylvania	12[3]	Elec. pass.	West. Elec. & Mfg. Co.
	5[3]	Elec. pass.	Gen. Elec. Co.
	11[3]	Elec. pass.	Company shops

[1] An option has been taken on two additional cars.
[2] These six cars are for the streamlined train mentioned in the July issue.
[3] These 28 of the 101 electric locomotives to be financed by the P.W.A., as noted in the February issue, will cost over $6,000,000.

Railway Employment Steadily Increasing

THE NUMBER of employees of Class I railroads as of the middle of the month of June was 1,054,089, according to the Interstate Commerce Commission's preliminary monthly tabulation of railroad employment statistics. This was an increase of 10.08 per cent as compared with the number in June, 1933, and of 1.06 per cent as compared with May, 1934. The maintenance of way and structures group showed an increase of 15.6 per cent as compared with June, 1933, and the maintenance of equipment group showed an increase of 15 per cent, but the train and engine service group showed an increase of only 8.72 per cent. The commission has also issued its more complete statement for April, showing a total of 1,017,008 employees and a total compensation of $123,427,450, and a statement showing the index of railway employment since January, 1932, using preliminary figures for May and June.

The railroads on July 1 also had 40 new steam locomotives on order and 107 electric locomotives. New steam locomotives on order on July 1, 1933, totaled one and on July 1, 1932, there were six on order.

In the first six months of 1934, the railroads installed 5,360 new freight cars. In the same period last year, 1,251 new cars were placed in service and for the same period two years ago, the total number installed was 1,927. One new steam locomotive and eight new electric locomotives were installed in service in the first six months this year. The railroads in the first six months of 1933 installed one new steam locomotive, and 34 in the corresponding period in 1932.

Freight cars or locomotives leased or otherwise acquired are not included in the above figures.

Eastern Car Foreman's Outing

THE RACE BROOK Country Club, New Haven, Conn., was the scene of the second annual outing of the Eastern Car Foreman's Association on July 19, at which approximately 215 members and guests were in attendance. Numerous events were on the program of entertainment and the outing was climaxed by a dinner at the club house, after which the prizes for the many events were awarded.

The golf tournament, in which 107 persons took part, was probably the most important event of the day. The winners in Class A were R. P. Townsend and C. E. Bryant, both of New York, who took the low gross prize with a score of 78. The low net in Class A was won by L. H. Foster. Low gross in Class B was won by H. B. Whitten and low net by H. B. Chamberlain of the Tuco Products Corporation. W. Spieth, American Steel Foundries, was the winner of the low gross prize in Class C and the low net in the same class was won by P. E. Pfeiffer. The driving contest was won by D. J. Molloy of the Crane Company, with a drive of 256 yards. The hole-in-one contest of 40 yards was won by J. J. Wilson of the Apex Tool Company, and F. N. Gregory of the Magnus Company. G. W. Ditmore, Delaware & Hudson, repeated his performance of last year and won first prize in the quoits contest, and H. G. Young, also of the D. & H., took second place. The bridge tournament was won by R. L. Pearson, vice-president and general manager, New York, New Haven & Hartford, and A. E. Ostrander, vice-president, American Car & Foundry Company. In the putting contest for golfers Harry Coston took first prize. Second place resulted in a tie between George Alling and D. B. Carse of the Oxweld Railroad Service Company. The non-golfers putting tournament was won by J. C. Hassett, mechanical engineer, New York, New Haven & Hartford, and W. M. Wadsworth, in which contest there was also a tie for second place between F. H. Reynolds and C. I. Billings.

A. S. T. M. President Dies

WILLIAM HASTINGS BASSETT, president of the American Society for Testing Materials and metallurgical manager of the American Brass Company, died suddenly on July 21 at his home in Cheshire, Conn. Mr. Bassett, who was 66 years old, had been president of the A.S.T.M. only a few weeks, having been elected in June at the annual convention in Atlantic City.



Eastern Car Foreman's Outing at Race Brook Country Club, New Haven, Conn.

Administration Members of Code Authorities

THE NATIONAL RECOVERY ADMINISTRATION on July 9 announced the appointment of the following administration members, without vote, of the code authorities of the several industries indicated below:

Professor R. H. Danforth for the Small Locomotive Manufacturing Industry. Prof. Danforth has been professor of mechanics and materials at the Case School of Applied Science, Cleveland, Ohio, since 1914. He has also served as consultant for the Packard Motor Company, Cleveland Tractor Company, the Goodyear Rubber Company and the New York Central Railroad.

George C. Dent for the Woodwork Division of the Lumber Code Authority, Inc., for the Lumber and Timber Products Industries. Mr. Dent has been in trade association work. In 1912 he organized the Western Efficiency Society in Chicago and served as its secretary until 1917. He then became secretary of the Society of Industrial Managers.

Edgar E. Brosius for the Code Authority for the Railway and Industrial Spring Industry, a sub-division of the Machinery and Allied Products Industry. Mr. Brosius is president and general manager of Edgar E. Brosius, Inc., Sharpsburg, Penna., manufacturer of blast furnace equipment.

Progress in Air-Conditioning Programs

Road	No. of cars	Type of car	Type of System	Builder
B. & O.	15[1]	Coaches	Freon	York Ice Machy. Corp.
	16[1]	Pullman		
Lehigh Valley	2[2]	Club	Mech.	York Ice Machy. Corp.
	3	Club-dining		
	5	Dining		
N. Y., N. H. & H. (See note 3)				

[1] B. & O. passenger cars air-conditioned by the York Company total more than 300. The equipment for the 31 cars noted here is to be installed at the Mount Clare shops of the railroad company at Baltimore, Md.

[2] All the Pullman equipment on the Black Diamond of this road operating between New York and Chicago is now completely air-conditioned. This includes lounge cars and sleeping cars in addition to the diners.

[3] The New Haven now has 152 air-conditioned cars in service on its trains, including 63 coaches, smokers and combination cars, 43 parlor cars, 29 dining cars, 14 sleepers, and 3 club cars. Additional cars are daily being received from the shops where they are being equipped with the air-cooling and purifying systems, and 65 additional cars were expected to be placed in service during the latter part of July. Some of the cars are equipped with an ice-cooling system, and others with mechanical air-conditioning. Next year the management hopes to have all its through train service 100 per cent air-conditioned. By that time the 50 new cars and the stream-lined Rail-Zeppelin being built by the Goodyear-Zeppelin Company, all of which will also be air-conditioned, will be ready for service, making possible complete air-conditioning of the entire through service.

Expedition in Replacement of Arch-Bar Trucks Urged

CO-ORDINATOR EASTMAN has sent to the Regional Co-ordinating Committees of the carriers a letter expressing the hope that the railroads will take such action as may be necessary to expedite the replacement of arch-bar trucks with cast-steel side-frame trucks, and to assure that in no case will any existing arch-bar trucks be replaced in kind, whether in maintenance or betterment work; in other words, that replacements be made exclusively with cast steel side-frames. He had discussed this matter with the committees at his meeting with them a year ago, with the understanding that such replacements were to be carried out as rapidly as possible, and that the work was to be completed by January 1, 1936, after which date cars equipped with arch-bar trucks will be barred from general interchange by an order of the American Railway Association. It is important, he says, that the date for completing this work shall not be extended. On July 1, 1933, there were 658,306 cars, or 32.1 per cent of the total, still equipped with arch-bar trucks. Attached to the letter was a memorandum from O. C. Castle, director of the Section of Car Pooling, giving statistics to show that "there is need for a program directed at the reduction of accidents due to defective or obsolete equipment," and which he believed indicated that "arch-bar trucks are a prolific source of trouble and expense." The hope was expressed that all future repair programs contemplate the replacement of arch-bar trucks with modern trucks as recommended by A. R. A. standards and that there be no extension of the date for barring arch-bar truck equipment in interchange.

P. W. A. Loans

THE WIDESPREAD effect of the orders for new equipment placed by the railroads with loans from the Public Works Administration is illustrated in a statement for the press issued by the P. W. A. Up to June 15, 8,300 men had been put to work in car building shops and 3,700 had been put to work in locomotive building shops by P. W. A. loans of $61,973,000 to 18 railroads for purchasing equipment, according to reports to the Bureau of Labor Statistics of the Department of Labor by the car and locomotive manufacturers who received the orders for this new equipment.

The $61,973,000 of loans were made by P.W.A. for purchase of 14,475 freight cars, 264 passenger train cars, 68 steam locomotives and 20 separate tenders for steam locomotives, 76 electric locomotives, 21 Diesel-electric locomotives and 4 articulated stream-lined trains. P.W.A. also has made loans totalling $23,226,000 for manufacturing 7,920 freight cars, 75 passenger cars and 25 electric locomotives in shops owned by the railroad companies. These loans have created a great amount of employment for railroad shopmen. Additional employment for railroad shopmen has been created by $28,697,343 of loans to railroad companies for repairing or rebuilding old cars and engines in their own shops. Employment for thousands of trackmen and other outside railroad employees also has been created by P.W.A. loans totalling $77,132,657 for miscellaneous roadway improvements and the purchase of new rails.

Twenty-two companies have received orders for the equipment being built in outside shops and the 12,000 men employed reported by them to the Bureau of Labor Statistics are at work in their assembly plants located in 23 cities. Only 100 freight cars, 59 electric locomotives, 13 Diesel-electric engines and 1 high speed train remain unordered.

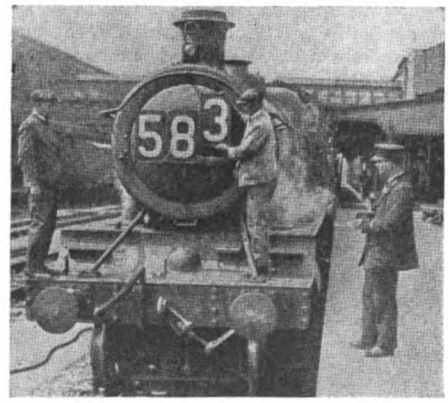
According to the P.W.A. statement, "the car builders reported that out of 12,400 men employed in their assembly plants 8,300, or 66.8 per cent were at work on cars being built with P.W.A. money. The locomotive builders reported that out of 4,127 men at work in their shops 3,700, or 89.6 per cent were employed as a result of P.W.A. loans.

"The men not employed on equipment being manufactured with P.W.A. money were at work on cars and engines ordered by industrial companies or by railroad companies which have not borrowed from P.W.A. The law authorizes P.W.A. to make equipment loans only to railroad companies, and no loans for that purpose have been made to oil or chemical companies, coal or lumber companies, meat packers, milk distributors, steel manufacturers or other industries which own large numbers of cars and engines."

The most recent contract signed by the Public Works Administrator was for a loan of $255,000 to the Gulf, Mobile & Northern for rail and track work. This is the third loan to the G. M. & N., the first being for $210,000 to put the company's shopmen to work on the job of building 100 new freight cars in its shops at Mobile, Ala., and Bogalusa, La., and the second being for $232,000 for the purchase of 150 new box cars being built by the American Car & Foundry Company in its St. Louis plant. A fourth contract covering a loan of $519,000 for the purchase of new cars and engines is in course of preparation.

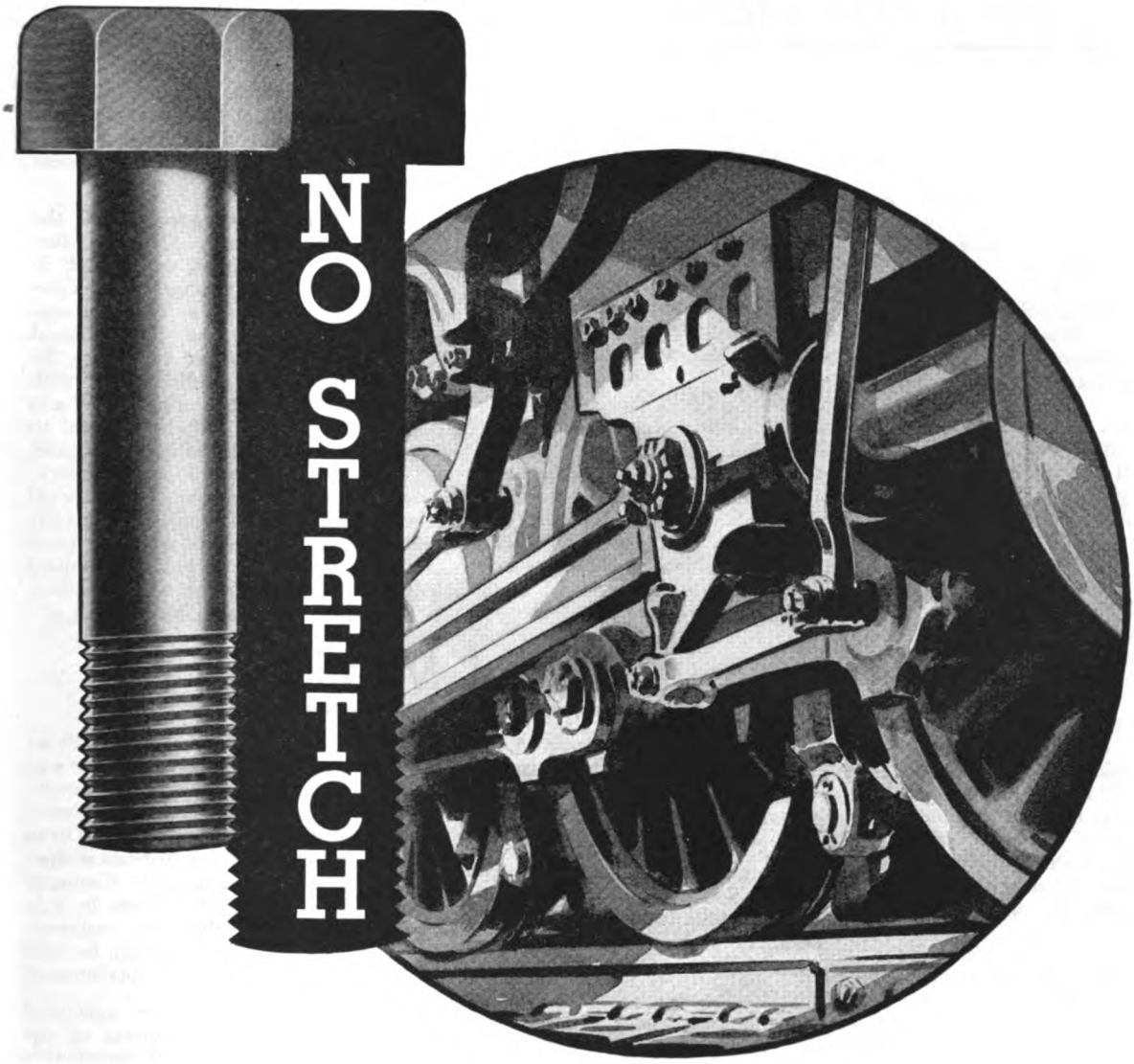
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* * *



G. W. R. train numbers

Numbering of Passenger Trains on the Great Western of Great Britain in heavy Saturday Travel. The "5" indicates that the train originated at Exeter, and "583" means that this is a fourth section of No. 580.



IN AGATHON ALLOY ENGINE BOLTS

Every turn of the wheels brings unbalanced forces into play that tend to rack the locomotive and stretch engine bolts. « « « If the engine bolt gives ever so little, slack develops and a start has been made towards the back shop. « « « For this exacting service Republic has developed an Agathon Engine Bolt Steel with higher strength and greater shock resistance. Once in place these bolts hold tight. You can rely on them to cut down frame bolt replacements and thereby reduce maintenance.

Toncan Iron Boiler Tubes, Pipe, Plates, Culverts, Rivets, Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel...The Birdsboro Steel Foundry & Machine Company of Birdsboro, Pa. has manufactured and is prepared to supply under license, Toncan Copper Molybdenum Iron castings for locomotives.

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES YOUNGSTOWN, OHIO

AGATHON STEELS

Supply Trade Notes

J. E. O'Brien, 135 So. LaSalle street, Chicago, has been appointed administration member on the code authority of the tank car service code.

William B. Given, Jr., president of the American Brake Shoe & Foundry Company, has been elected a director of the American Arch Company.

A. C. Deverell, representative of the Standard Car Truck Company, has resigned to become representative of the Equipment Specialties Company, Chicago.

The Standard Steel Car Corporation has purchased the Canton Car Company, Canton, Ohio and will continue to operate the plant with its present organization, headed by G. J. Whalen, general manager.

John F. Deems has been appointed representative of the Union Asbestos & Rubber Company, Cicero, Ill., with headquarters at 420 Lexington Ave., New York. George L. Green has been appointed representative at Chicago.

Thomas L. Mount, of the Thomas L. Mount Company, 136 Liberty street, New York, has been appointed representative in Eastern territory for the Dayton-Roderwald V-belt drive, used for air conditioning and lighting of passenger cars and for endless V-belts, both of which are manufactured by the Dayton Rubber Manufacturing Company, Dayton, Ohio.

Stanley A. Knisely, who has been appointed sales promotion and advertising manager of the Republic Steel Corporation, will have his headquarters at Youngstown,



Stanley A. Knisely

Ohio. Mr. Knisely entered newspaper work in his home city at Canton, Ohio, and later held the positions of city editor and telegraph editor of the Cleveland Plain Dealer. He left that field to become advertising and sales manager of the National Paving Brick Association, with headquarters at Cleveland, Ohio. After six and a half years in that position Mr. Knisely became director of advertising research for the National Association of Flat Rolled Steel Manufacturers and served seven years in that capacity.

Malcolm E. Gregg, assistant district sales manager of the Inland Steel Company, with headquarters at Milwaukee, Wis., has been appointed district sales manager to succeed Harry L. McCauley, deceased.

Charles D. Jenks, president of the Chicago Car Roofing Company, has been elected chairman of the Code Authority of the Railway Car Industry. William H. Winslow, Jr., of Defrees, Buckingham, Jones & Hoffman, was elected secretary.

Obituary

John E. Barkle, general manager of the South Philadelphia Works of the Westinghouse Electric & Manufacturing Company, died suddenly at his home in Swarthmore, Pa., on July 10 at the age of 53. Mr. Barkle was born at Orbisonia, Pa., and was a graduate of Dickinson College. He had been in the service of Westinghouse continuously for 33 years.

H. Leon Fuller, district manager of the Westinghouse Air Brake Company, with headquarters at Denver, Colo., died suddenly in that city on July 8.

L. W. Hostettler, manager of alloy sales, Allegheny Steel Company, Brackenridge, Pa., died on July 10 from injuries received in an automobile accident near Waukegan, Ill.

Lawrence H. Vilas, president of the Pyle-National Company, Chicago, died suddenly of a heart attack on July 22, in the Palmer House in Chicago. Mr. Vilas was born in 1895 at New York and entered the service of the Pyle-National Company in 1915. After two years, he left this company to serve overseas with the United States army during the World War. Following the war, he returned to the service of the Pyle-National Company in 1919, serving successfully as chief clerk, assistant general manager and general manager until 1928. During the next four years, Mr. Vilas was out of the service of the company, but in 1932 he resumed active service as president, which position he held continuously until his death.

Personal Mention

H. C. Trexler, master mechanic of the Southern at Spencer, N. C., has been appointed superintendent motive power, eastern lines, with headquarters at Charlotte, N. C.

L. C. Shults, superintendent of motive power of the Southern, lines east, Charlotte, N. C., has been transferred to Knoxville, Tenn., as superintendent of motive power, central lines.

M. D. Stewart, superintendent of motive power of the Southern, lines west, has been transferred to Cincinnati, Ohio, as superintendent of motive power, western lines.

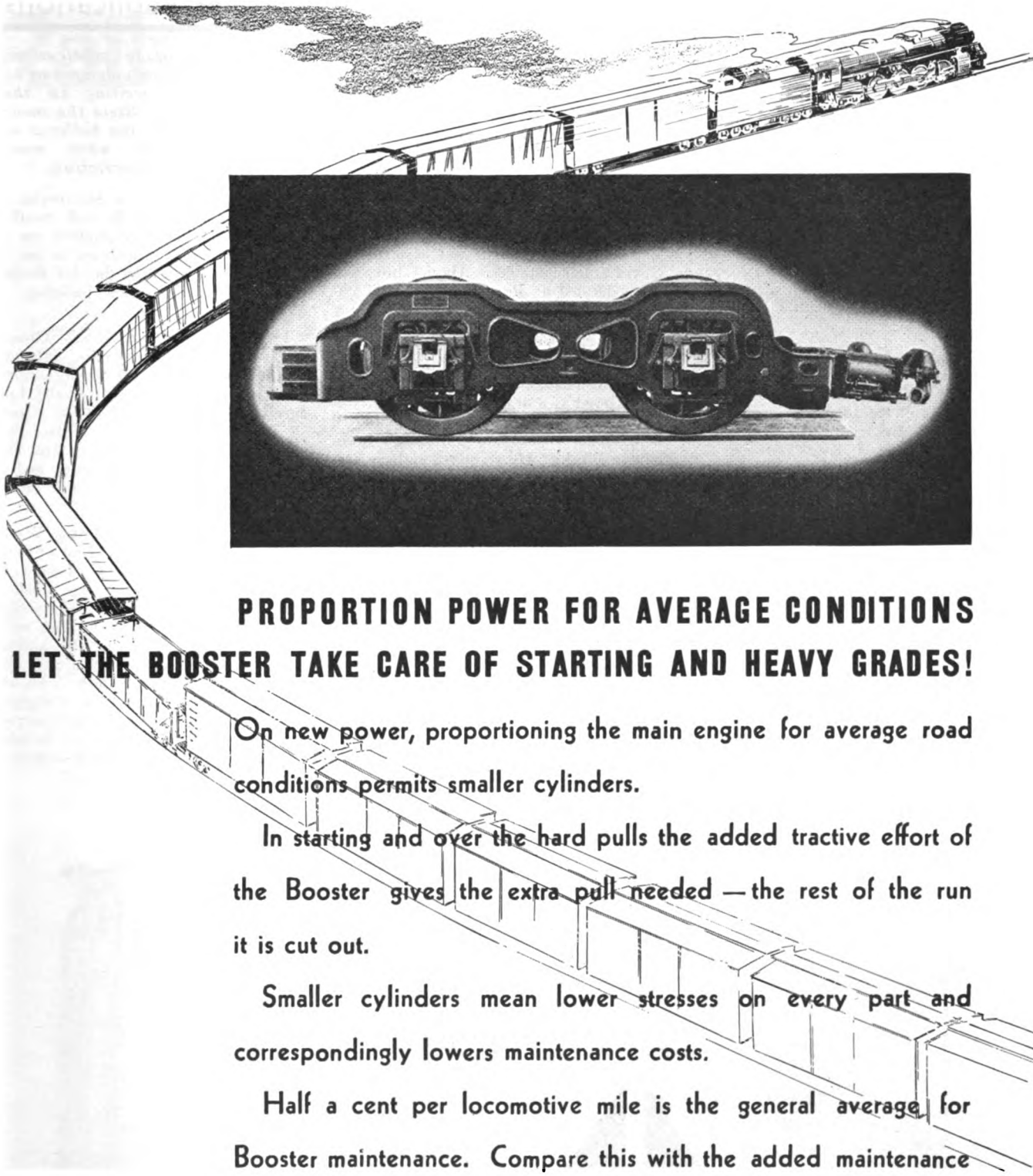
J. J. Prendergast, acting mechanical superintendent of the Texas & Pacific, with headquarters at Dallas, Tex., has been appointed mechanical superintendent.

W. S. H. Hamilton has been appointed equipment electrical engineer, New York Central Lines, with jurisdiction over all engineering matters on electric motive power and rolling stock, and the electrical equipment on steam motive power and rolling stock. Mr. Hamilton was born in December, 1890, at New Haven, Conn. He received his higher education at Sheffield Scientific School, Yale University. In 1911, he became connected with the General Electric Company at Schenectady, N. Y., and held a position in the testing department of that company until 1913, when he became designing engineer. From 1916 to 1917 he was field engineer and during that period he also served as instructor to enginemen, etc., when the first electrification on the Chicago, Milwaukee & St. Paul (now Chicago, Milwaukee, St. Paul & Pacific) was opened. In 1917 he became designing engineer and in 1918 he enrolled for service in the U. S. Navy. During the period he was in that service he was commissioned as ensign and part of the time he was engineering officer of the U. S. S. Henderson. He returned to the General Electric Company in 1919 as field engineer, and from 1922 to 1924 was designing engineer, locomotive department; from 1925 to 1927 commercial engineer, railway engineering department; and from 1928 to January, 1931 electrification specialist of the General Electric Company at New York. On the latter date he was appointed assistant electrical engineer, New York Central, which position he held until the time of his present appointment.

D. B. Thompson has been appointed mechanical and electrical engineer of the New York Central Lines, with jurisdiction over all electrical matters other than those supervised by W. S. H. Hamilton. Mr. Thompson was born in Lansingburgh, N. Y., on December 14, 1886. He was graduated from Rensselaer Polytechnic Institute with the degrees of C.E. and E.E. He entered the service of the New York Central in 1912 as inspector on mechanical and electrical installations, and was later placed in charge of electric and water service contracts. He was then appointed mechanical engineer in charge of design and specifications for mechanical and electrical installations, at New York, the position he held at the time of his recent appointment.

A. L. Ralston, assistant general mechanical superintendent of the New York, New Haven & Hartford has been appointed general mechanical superintendent, with headquarters at New Haven, Conn. Mr. Ralston was born in Brazil, Ind., and was graduated from Purdue University in 1905. He then took a special apprenticeship course with Westinghouse Electric & Manufacturing Company at Pittsburgh, Pa., specializing in railroad work. During 1906 and a part of 1907 he worked in the engineering department of the Westinghouse Company on the development of design and construction of the first electric locomotives built for the

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PROPORTION POWER FOR AVERAGE CONDITIONS
LET THE BOOSTER TAKE CARE OF STARTING AND HEAVY GRADES!

On new power, proportioning the main engine for average road conditions permits smaller cylinders.

In starting and over the hard pulls the added tractive effort of the Booster gives the extra pull needed — the rest of the run it is cut out.

Smaller cylinders mean lower stresses on every part and correspondingly lowers maintenance costs.

Half a cent per locomotive mile is the general average for Booster maintenance. Compare this with the added maintenance cost of larger cylinders and an extra pair of drivers.

All replacement parts furnished by Franklin Railway Supply Company are identical as to materials, design, clearances and workmanship with the parts they replace. They guarantee the same unfailing reliability of service.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

New Haven. He was then assigned by Westinghouse to Stamford, Conn., remaining there until 1914, assisting in the work of electrification of the New Haven between New York and New Haven, Conn. Mr. Ralston entered the service of the New Haven in May, 1914, as assistant electrical engineer. In February, 1915, he was appointed assistant to the mechanical superintendent, in charge of the maintenance of electrical equipment; in May, 1917, engineer of electric traction, with headquarters at Grand Central terminal, New York, and in September, 1918, mechanical superintendent in charge of maintenance of electric equipment and in November, 1932, he became assistant general mechanical superintendent with headquarters at New Haven.

Master Mechanics and Road Foreman

G. F. TIPTON has been appointed master mechanic of the Southern, with headquarters at Somerset, Ky.

H. B. NABORS has been appointed master mechanic of the Southern, with headquarters at Princeton, Ind.

M. R. BROCKMAN has been appointed master mechanic of the Southern, with headquarters at Spencer, N. C.

G. L. BUUCK has been appointed trainmaster and road foreman of engines on the Toledo division of the Pennsylvania, with headquarters at Toledo, Ohio.

Purchasing and Stores

J. L. IRISH, assistant general storekeeper of the Oregon Short Line, the Oregon-Washington Railroad & Navigation Company and the Los Angeles & Salt Lake (all units of the Union Pacific System), with headquarters at Pocatello, Idaho, has been appointed assistant general storekeeper of the Union Pacific Railroad and the St. Joseph & Grand Island, with headquarters at Omaha, Neb., succeeding O. Nelson, who has retired.

Obituary

THEODORE H. CURTIS, formerly a mechanical officer on a number of railroads and more recently a consulting engineer on railroad mechanical matters at Chicago, died on July 15 in that city following a long illness. Mr. Curtis was born on August 12, 1866, at Terre Haute, Ind., and was educated at Rose Institute of Technology in that city. He entered railway service in 1886 as chief mechanical draftsman for the Cincinnati, Indianapolis, St. Louis & Chicago (now part of the Cleveland, Cincinnati, Chicago & St. Louis). He then served as a draftsman for the Brooks Locomotive Works and later was employed in a similar capacity by Pittsburgh Locomotive Works. He reentered railway service in June, 1889, as chief draftsman for the New York, Chicago & St. Louis, being appointed mechanical engineer in 1897. Two years later he became mechanical engineer of the Erie and in January, 1901, he entered the service of the Louisville & Nashville as mechanical engineer. In August, 1903, Mr. Curtis was appointed superintendent of machinery of the L. & N. leaving this company in July, 1911, to become mechanical engineer for the Committee on Investigation of Smoke Abatement and Electrification of Railway Terminals of the Chicago Association of Commerce. Since February, 1915, he had been a consulting railroad engineer in private practice at Chicago.

Trade Publications

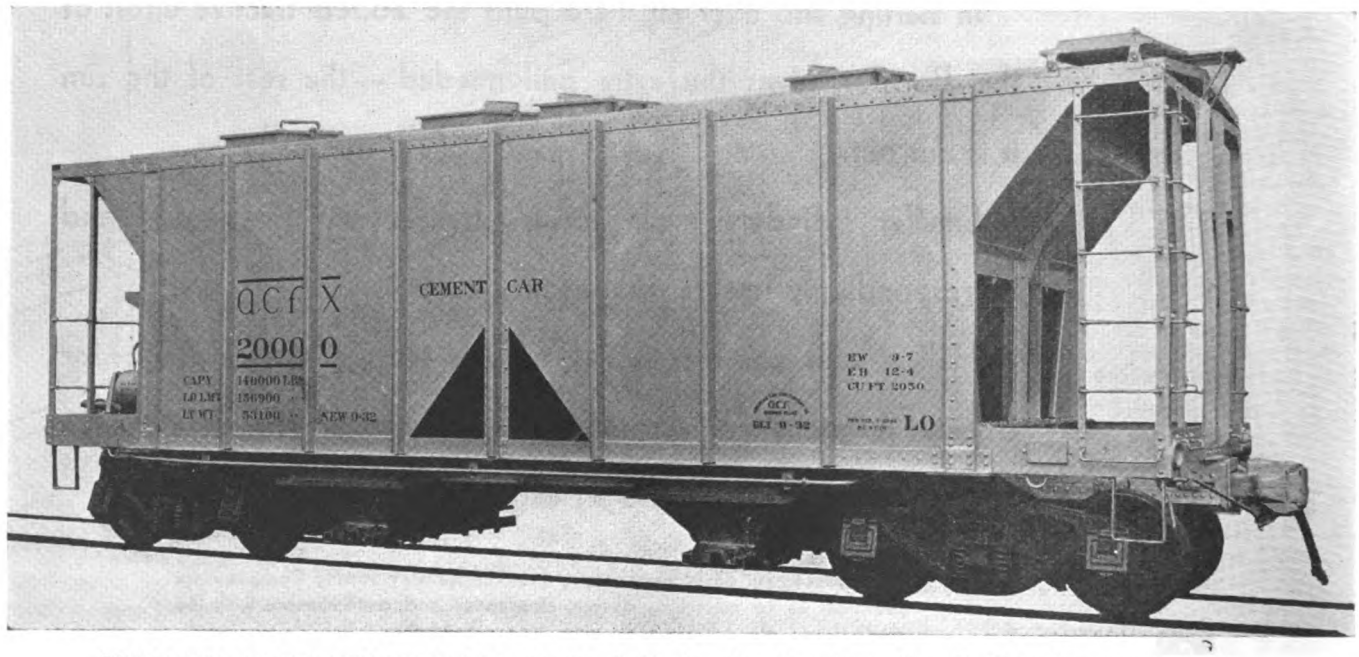
Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

LOCOMOTIVE AND CAR SCRAPPING.—Detailed data on methods and results of scrapping cars and locomotives on three different railroads are given in an illustrated booklet issued by the Air Reduction Sales Company, Lincoln building, New York.

LUKENS CROMANSIL STEEL.—Cromansil steel—its physical properties, fabrication, riveting, application, etc.—is described in an 8-page bulletin issued by the Lukens Steel Company, Coatesville, Pa. Cromansil steel was developed to replace carbon steels in applications where a steel having a combination of high strength and good ductility in the "as rolled" condition is required.

TESTING WELDERS AND THEIR WELDS.—"The Testing and Qualification of Welders" is the title of a 24-page, illustrated booklet issued by the Linde Air Products Company, 30 East Forty-Second street, New York. The booklet outlines simple tests for measuring the ability of welders and discusses fracture, bend, tensile and observation tests. An eight-page pamphlet entitled "The Progress of Bronze-Welding" contains an instructive story of bronze-welding in all its phases. Another five-page pamphlet describes "The Principles of Bronze-Welding."

* * *



70-ton two-compartment covered hopper car built by the American Car & Foundry Company for bulk shipments of cement

A.R.A. Class	LO	Truck wheel base	5 ft. 8 in.
Length inside	29 ft. 3 in.	Capacity, cubic	2,050 cu. ft.
Length over strikers	35 ft. 1¾ in.	Capacity, barrels (378 lb. per bbl.)	415 barrels
Width inside	9 ft. 5½ in.	Axle journals	6 in. by 11 in.
Height—rail to top running board	12 ft. 10⅝ in.	Slope sheet angles	50 deg.
Height—rail to eaves	11 ft. 10 in.	Light weight	53,100 lb.
Center to center trucks	25 ft. 3 in.	Load limit	156,900 lb.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

September, 1934

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices,
30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: Terminal Tower
Washington: 832 National Press Bldg.
San Francisco: 58 Main St.

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Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States and possessions: 1 year, $3; 2 years, $5. Canada, including duty: 1 year, $3.50; 2 years, $6. Foreign countries: 1 year, $4; 2 years, $7.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.

NRA U.S. CODE GRAPHIC ARTS INDUSTRY

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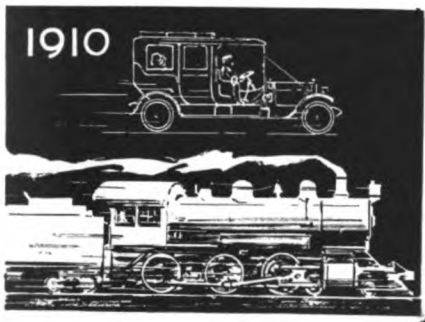
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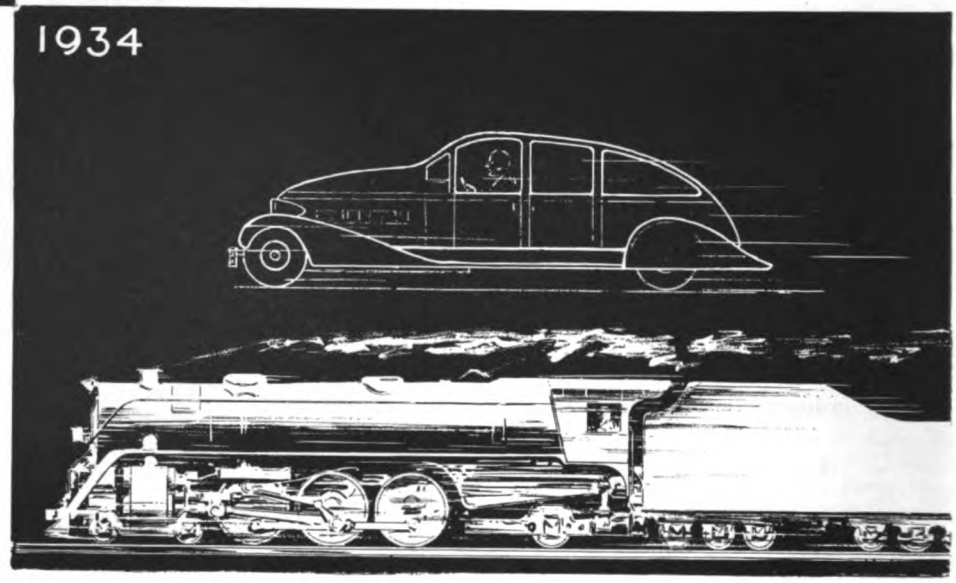
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LIMA LIMA LOCOMOTIVE WORKS INCORPORATED OHIO

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Westinghouse Builds 800-Hp., 110-Ton Diesel-Electric Switcher

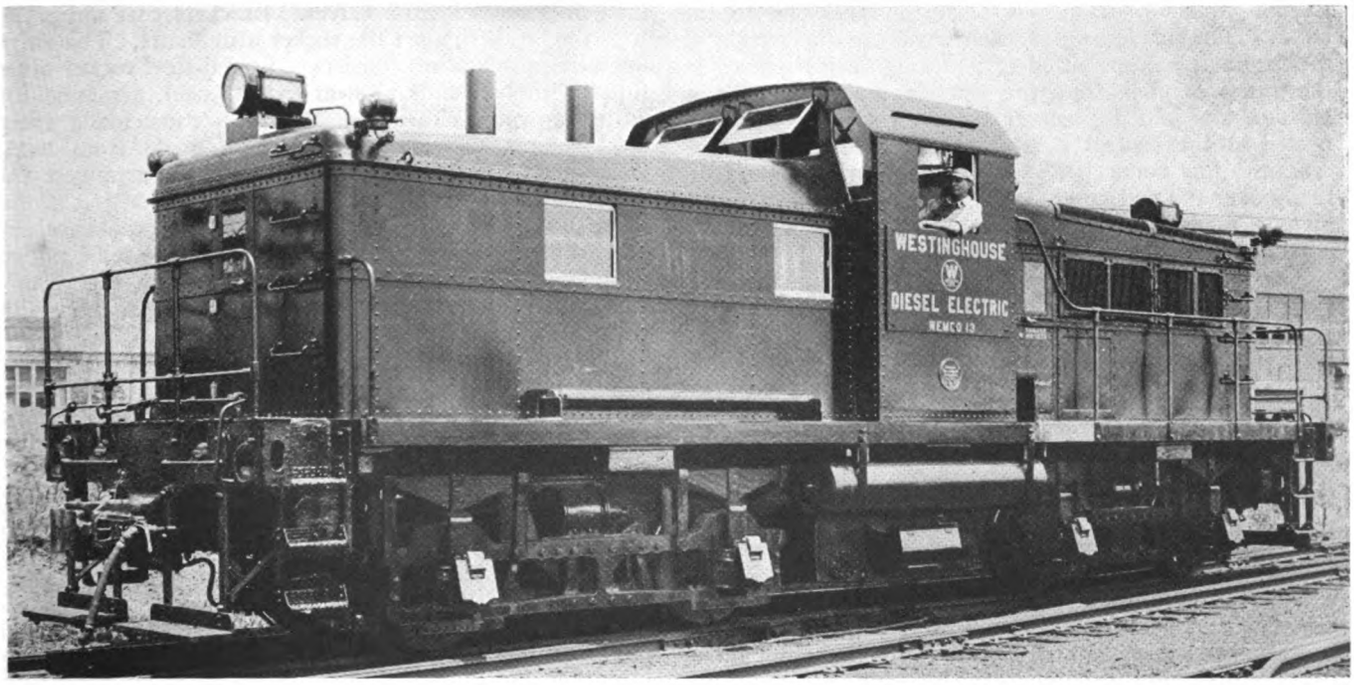
Locomotive with 12-cylinder, V-type engine designed to provide maximum visibility and accessibility to working parts

ONE of the recent developments of the Westinghouse Electric & Manufacturing Company is an 800-hp., 110-ton Diesel-electric switching locomotive which was recently completed at its South Philadelphia Works. It incorporates many interesting features desirable for heavy switching or combined switching and transfer service, especial attention being given to the problem of providing maximum visibility for the operator and accessibility to all important parts.

General Arrangement of the Locomotive

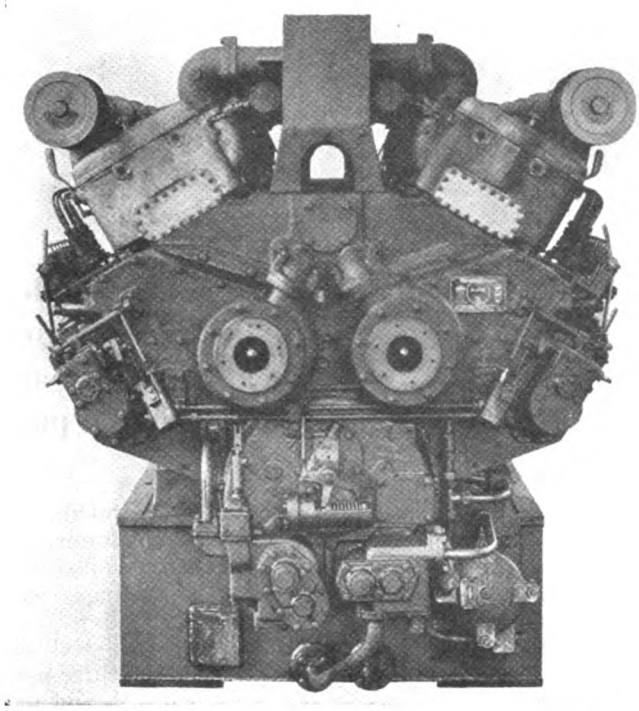
An elevated operator's cab centrally located, provides for uninterrupted vision over and along each side of the equipment hoods. The power plant is located in one hood and the engine-cooling system, air brake compressor, control equipment and battery are located in the other hood. The locomotive underframe consists of an integral steel casting, which is finished to form the bed plate for the Diesel engine and electric generator, and includes the engine sump and lubricating oil-storage reservoir, draftgear housing, bumper castings, sand boxes, body bolsters and center pins.

Two four-wheel swivel trucks having cast-steel side frames, cross-ties and bolsters and a modified three-point equalization system support the equipment cab and provide ample flexibility for negotiating yard tracks. The



Westinghouse 110-ton Diesel electric locomotive with 800-hp., 12-cylinder V-type engine

castings for the trucks were made by the General Steel Castings Corporation and the general truck assembly by the Baldwin Locomotive Works. The truck wheel base on this locomotive is 8 ft. and the axles have 7-in. by 13-in. journals. The boxes and brasses are lubricated by oil and waste and the center pins and side bearings by the Alemite system. The truck is of the outside-frame type with a long-fit solid bolted connection between the bolster and side frame and with bolted cross-ties at each end. The outside axle of each truck has a leaf spring over the box with inverted U hangers at each end of the spring which are connected at the bottom to the truck frame. The springs rest on inverted saddles that straddle the side frame and transmit the load to the boxes. The inside axle of each truck has the weight of the locomotive transmitted to it through a leaf spring in the same manner, but the outside ends of the two springs are joined together by a cross equalizer connected at the central point to the center of the truck cross-tie, this connection between the springs being directly over the end cross-tie. This method of suspension gives a modified three-point support with exceptionally good riding qualities.



End view of the engine showing the accessories

Two 12-in. by 12-in. brake cylinders are mounted on each truck, one cylinder being independently connected to the brake rigging on each side of the truck. A lever ratio of 8.3 is used, giving a braking effort equal to 85 per cent of the weight of the drivers at 59 lb. per sq. in. cylinder pressure. This arrangement eliminates brake beams and provides for proper shoe clearance while the brakes are released. Turnbuckles are provided for adjusting the piston travel for worn shoes and an additional fulcrum point is provided for use with worn tires. An auxiliary hand brake is connected to one truck for holding the light locomotive when standing.

The locations of the operator's seats and general arrangement of dual control and brake stands provides for operation of the locomotive in either direction from either of two operating positions without discomfort to the operator. This is accomplished by the use of swivel seats located next to the cab side windows, facing the longitudinal center line of the locomotive with control and brake pedestals, located directly in front of the operator, thus making all operating handles accessible while looking in either direction.

Steps and grab-handles are located at the four corners of the locomotive for climbing to the deck platform. Walkways along each side of the equipment hood lead to doors in the operator's cab. A platform at the other end of the locomotive provides access through a door to the engine room, through which one may pass to the operator's cab. The side steps and switchman's steps are illuminated by step lights.

Diesel Power Plant

The Westinghouse Diesel engine, develops 800 b.h.p. at 900 r.p.m. It has twelve cylinders arranged in V shape, each bank of cylinders being inclined at an angle of 30 deg. from the vertical plane through the crankshaft. It is of the solid injection type, using heavy fuel oil and operating on the four-stroke cycle principle.

An integral cast steel crankcase supports the crankshaft, cylinder heads, cylinder liners, and engine auxiliaries, Cored passages through the crankcases, fed from an oil header on the outer base flange, provide for pressure lubrication of the main bearings.

The crankshaft is forged from chrome nickel steel, machined throughout, counterbalanced, and is drilled for pressure lubrication of crank pins from main bearings. It is supported on the underside of the crankcase in seven main bearings. A friction disc type of vibration dampener is fitted on the front end of the shaft and the rear end is flanged for the flywheel mounting and generator coupling.

Removable liners of nickel cast iron are fitted in the crankcase. The upper end of the cylinder liner is clamped rigidly in place between the cylinder head and crankcase, and the lower end fits in heat-resisting, rubber-compound, water-seal rings. The liners may be readily withdrawn if required by a pulling bolt, inserted for this operation and a new assembly of liner and rings installed.

Each cylinder is provided with an individual cylinder head, cast from aluminum alloy with steel valve sets for dual inlet and exhaust valves. Brackets cast integrally with the head, support the rocker arm shafts. The valve operating mechanism consists of forged-steel rocker arms fitted with ball ends of heat-treated steel, arranged for adjusting valve clearances, and push rods, made from steel tubing, provided with sockets made from heat-treated steel. The entire mechanism is arranged for pressure lubrication.

In the upper and outer sections of the crankcase are cored out chambers for cam shafts, one for each bank of cylinders. The cam shafts are made from high-grade steel and heat treated. The cams are forged integrally with the shaft and ground to a master cam.

The pistons are of a special aluminum alloy, machined for pressure and oil control rings. The piston pins, of the full floating type are made from a special steel, hollow bored, polished, and fitted with aluminum end caps. The connecting rods are forged from steel, heat treated, and are fitted with bronze bushing for the piston pin, and a babbitted shell for the crank pin bearing.

The fuel injection system has been developed especially for the Westinghouse line of high-speed Diesel engines. It consists essentially of a motor-driven gear pump, taking fuel oil from the main tank and delivering it to the main fuel pump headers, through an extremely fine mesh strainer at a pressure of approximately 30 lb.

per sq. in. One six-cylinder fuel pump is mounted on each side of the crankcase, and serves the bank of six cylinders adjacent thereto, or one fuel pump unit for each engine cylinder. The fuel pump operating shafts run at one half crankshaft speed, and their angularity with respect to the crank shaft, is advanced or retarded automatically to advance or retard the time of injection, dependent upon engine speed. Fuel oil is admitted from the oil header of the main fuel pump to the fuel pump cylinder during the downward stroke of the pump plunger, and the pressure developed in the pump cylinder during the upward stroke of the plunger unseats the atomizer needle valve when a pre-determined pressure is developed, and atomized oil is injected into the engine cylinder at the proper instant during the compression stroke, the volume of oil injected per stroke being automatically controlled by the governor. The atomizer, located in the center of the cylinder head, consists of a spring-loaded needle valve and nozzle having a number of very small holes drilled in the tip. The needle valve spring prevents injection of oil into the cylinder until the fuel pump plunger delivers the proper pressure for injection.

The engine governor is of the oil pressure type which has been used generally in marine service for many years. It is of the variable-speed type, thus permitting operation of the Diesel engine at any desired speed within its operating range and limiting the engine speed to that desired for the locomotive movement. Safety features provide for automatically stopping the engine in case of overspeed or reduction of lubricating oil pressure below a safe value.

Electrical Transmission

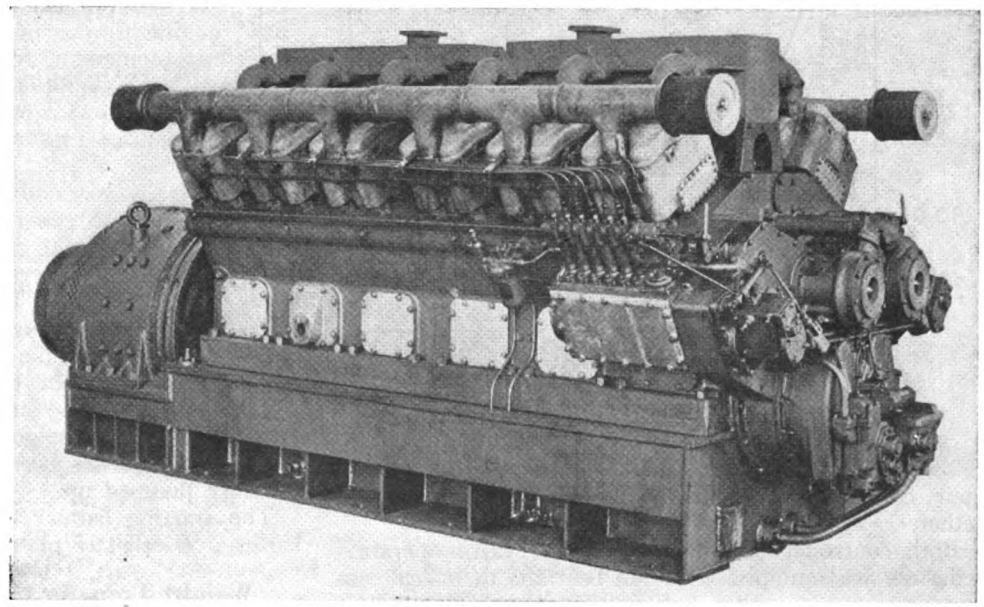
A single bearing main generator converts the mechanical power at the engine shaft to electrical energy for use by the traction motors. The armature shaft is flanged and directly connected to a similar flange on the engine shaft with the web of the engine flywheel interposed between the two flanges. Both engine and generator shaft ends are machined to fit into the flywheel bore to insure concentricity and facilitate alignment. The outer end of the main generator shaft is carried on a self-aligning, non-thrust type ball bearing. The inner race is pressed on the generator shaft and the outer race has a sliding fit in the main generator bearing bracket, permitting the end thrust to be taken on one of the main bearings of the crankshaft.

The auxiliary generator frame is mounted on the main generator bearing bracket, and its armature on an extension of the main generator shaft. A fan, mounted on the engine flywheel draws air through the main and auxiliary generators, cooling both machines. The field of the main generator is excited from the auxiliary generator, while the field of the latter is excited from a storage battery. The main generator is used as a motor for cranking the Diesel engine during starting.

General Dimensions of Westinghouse Diesel Electric Locomotive

Length inside coupler knuckles	42 ft. 6 in.
Length of operator's cab and hoods	35 ft. 6 in.
Overall width	10 ft. 2½ in.
Heights from rail:	
Overall (at operator's cab)	14 ft. 0 in.
Over equipment hoods at operator's end	12 ft. ½ in.
Over equipment hoods at coupler end	11 ft. 3 in.
Truck center distance	21 ft. 0 in.
Truck wheel base	8 ft. 0 in.
Diameter of drivers	3 ft. 0 in.

Four traction motors, utilizing the electrical power furnished by the main generator, supply the propelling force for the locomotive. One motor is geared to each of the driving axles through a pinion on the motor shaft and a gear on the driving axle. The gearing is spur type, machined from steel forgings and heat treated.



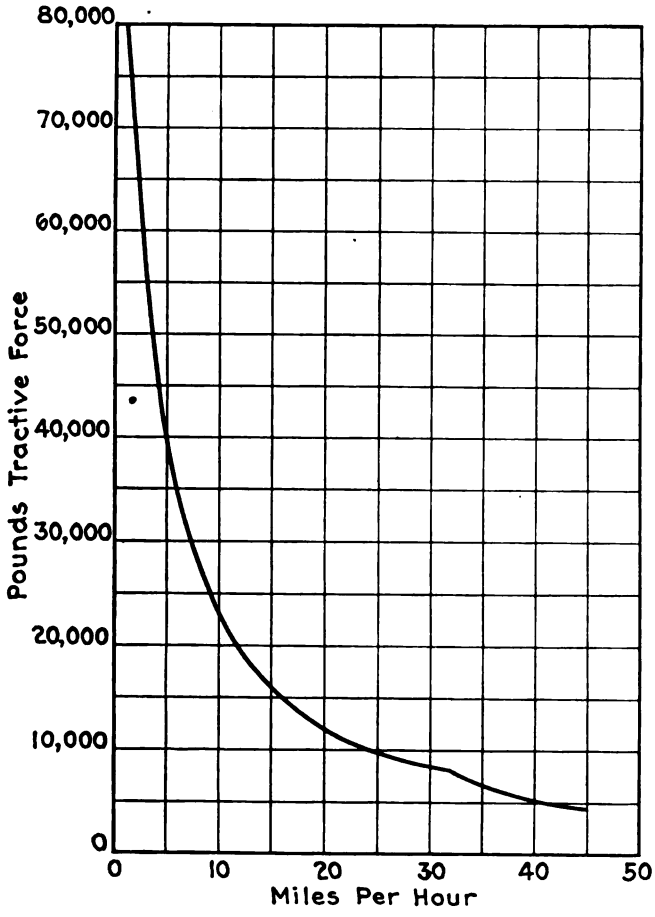
Westinghouse 12-cylinder, V-type Diesel engine developing 800 b. hp. at 900 r.p.m.

The traction motors are of the direct-current series type, self-ventilating, and equipped with roller-type armature bearings and split-sleeve type axle bearings. One side of the motor is supported on the axle bearings, the split-type bearing housing holding it in position to maintain the gear center distance and parallelism of gear teeth. The other side of the motor is flexibly supported on the truck crosstie, thus permitting the motor to follow the drivers in negotiating irregular track.

Control Equipment

The locomotive is equipped with Westinghouse dual control, developed especially for Diesel electric switching locomotives to provide maximum flexibility with one-man operation.

A pedestal-type controller and a brake valve operating pedestal are located at each of the operating stations. Their shafts extend through the cab floor, those on one side of the operator's cab being mechanically connected to the corresponding shafts of similar pedestals on the other side. One of the controllers is equipped with master control drums and the customary interlocking between the power and reverse levers, and the other is equipped with operating shafts only. A standard K-14 brake valve, minus the handles, is located directly



Tractive force-speed curve

below one of the brake valve operating pedestals with their corresponding shafts semi-rigidly connected together.

Both controller pedestals and brake valve operating pedestals are equipped with ball bearings to insure ease of operation from either station. The system as a whole provides maximum flexibility of locomotive operation in that the operator has complete control of locomotive power and reverse levers and automatic and independent brake levers at either operating station, and may move from side to side of the locomotive either before applying power, or while a locomotive movement is in progress, without shutting off power. This arrangement eliminates the use of transfer switches and cutout cocks, used ordinarily where two complete sets of controllers and brake valves are used, and enables the operator to take the position affording the best visibility of ground crew, tracks and surrounding conditions, at any time. The time elapsing between releasing hold of one set of control levers and taking hold of the second set of control levers need not exceed two to four seconds, and the high degree of visibility from the operator's cab permits this with safety in operation.

The power lever of the controller governs the operation of electro pneumatically operated switches, for closing and opening the electrical circuit between the main generator and the traction motors and an electro-pneumatic governor operator for increasing or reducing the speed of the Diesel engine with consequent increase or reduction in locomotive tractive effort and speed. A sliding handle on this lever permits changing either from the series connection to the parellel connection of the traction motors or from parallel connection to the series connection, with closed circuit transition, on any engine speed notch, without shutting off power. The last position of the power lever which may be taken only in the parallel position of the handle, provides for field shunting of the traction motors, with consequent increase in locomotive speed. On shutting off the power lever, a roller on the sliding handle engages a cam on the controller head and automatically returns it to the series position. The use of a single lever for controlling all power operations of the locomotive permits the operator to devote full attention to the ground crew and surrounding conditions. The reverse lever of the controller, controls an electro pneumatically operated reverser, which is located in the control compartment.

Engine loading is controlled over the range of generator voltage and current by the Westinghouse torque control system, developed several years ago for use on Diesel- and gas-electric locomotives and cars. It operates to regulate the generator field current and voltage to maintain constant horsepower output at the engine shaft over a wide range of tractive effort and speed. It also insures full speed operation of the engine at reduced engine torque in the event unusual conditions, result in a momentary reduction in engine torque. This system permits maintaining a constant voltage on the auxiliary generator for operation of the auxiliary motors, while the main generator voltage is varied to suit operating conditions.

Magnetically-operated contactors make and break the various circuits to generator fields and to the auxiliary motors. A meter and gage panel located in the operator's cab includes meters for indicating main generator voltage and amperes, battery amperes, engine-jacket water and oil temperatures, and lubricating oil pressure. Gages for the air brake system are located in separate boxes adjacent to the operator's seat.

The engine may be started or stopped from the operator's station without going into the engine hood, after the initial start has been made and main reservoir air pressure pumped up.

The starting battery consists of an Exide, Ironclad battery, 50 cells, 15 plates per cell.

Weight Transfer Compensating Equipment

The torque developed under load by all direct geared traction motors reduces the loading on the axle on which it is mounted for one direction of rotation and increases the loading for the other direction of rotation. This results in reaching the slipping point on the leading drivers of a truck before it is reached on the trailing drivers on the same truck. To develop maximum possible tractive force, it then becomes necessary to make the heavier loaded trailing drivers develop more tractive force than the lighter loaded leading axles. The Westinghouse system of adjustment for weight transfer, used on this locomotive, provides for doing this during maximum tractive force periods by use of a foot-operated push button, one of which is located at each operator's station, which energizes the operating coils of the field shunting switches of the loading motors on each truck, closing these switches, thereby reducing the torque developed by those motors to a value suitable for their axle loading

while the trailing motors work at or near the slipping point of their wheels. The position of the controller reverse drum automatically selects the group of field shunting switches to be closed.

Engine Cooling System

The quantity of heat to be dissipated in the engine-jacket water varies almost directly with the horsepower developed by the engine while the capacity of the radiator varies indirectly with the temperature of the air. Sufficient radiator capacity has been installed to permit continuous operation at full horsepower under the hottest weather conditions encountered without exceeding safe operating temperatures of jacket water and lubricating oil. Since average horsepower required from the engine varies with service conditions, and the air temperature varies with the season and climate, motor-driven blowers were adopted for force ventilating the radiator. The operation of one fan, ventilating the oil radiator and a part of the water radiator, is under the control of a thermostat located in the lubricating oil line while the operation of the second fan, which ventilates the remaining sections of the water radiator, is controlled by a thermostat located in the water lines. Auxiliary manual control of operation of blower motors has also been provided. The blower motors operate from the auxiliary generator, thus making their operating speed independent of the main generator voltage. Full voltage is available for their operation, at engine speeds as low as three-quarters full speed. This system provides for cutting in the blower sets only when their operation is actually required by temperature conditions, thus reducing to a minimum standby losses, incurred with fans driven directly from the engine and releasing full engine power for propulsion purposes during the greater part of the time.

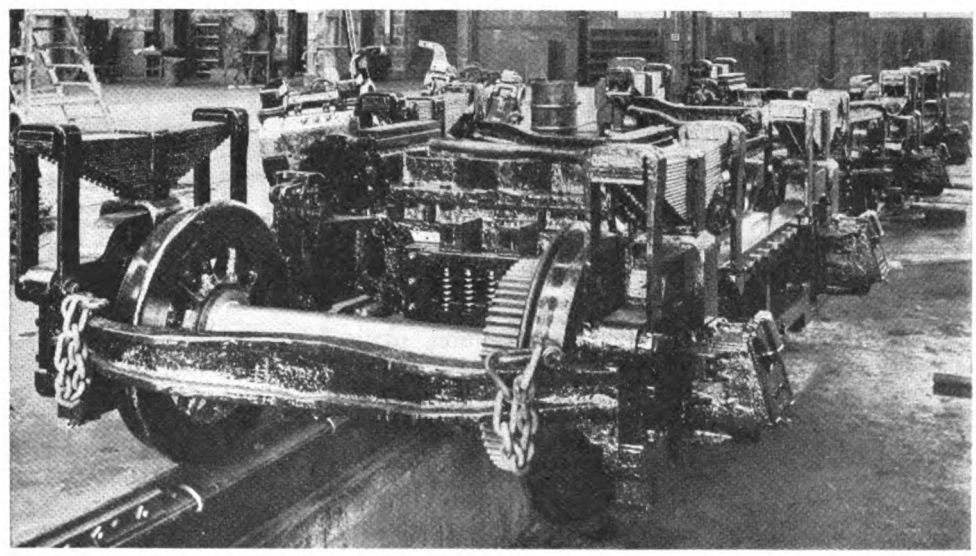
The radiator was manufactured by the Young Radiator Company and is of the finned-tube, sectional-core type. It consists of sections made from seamless copper tubes, five rows deep, having six fins per inch, brazed to header sheets, which in turn are brazed to header castings. The sections are bolted to water and oil rails, using Vellumoid gaskets at the joints. The radiator is mounted on the roof of the equipment hood, at an elevation which permits the water and oil sections to drain into a jacket water tank and a lubricating oil reservoir, respectively, when the engine is shut down, thus eliminating need for anti-freeze solution in the jacket water system during layover periods of the locomotive. The general arrangement of the radiating system insures cooling unaffected by locomotive speed, direction of operation or windage conditions. The air flow through the radiator is upward, and the rise in the temperature of the air passing through the core results in an appreciable amount of self ventilation, minimizing the operation of the blowers. Removable baffles are provided which may be hung in place during winter operation to restrict the self ventilating feature if required.

Air Brake Equipment

Westinghouse Air Brake Company's modified schedule 14 EL air brake equipment with quick application and release feature is used. A single-stage, two-cylinder, water-cooled air compressor, driven through a flexible coupling by a 115-volt, direct current, series motor, furnishes air for the operation at the brakes and electro-pneumatic control equipment. Both compressor and motor are equipped with ball bearings.

Cooling water for the air compressor is taken from the Diesel engine crank case jacket at the pressure existing therein, and conducted from the compressor to the engine radiating system. The compressor operates from the main generator during engine idling periods and from the auxiliary generator during periods when the main generator is furnishing power to the traction motors. This insures full speed operation of the compressor under practically all locomotive operating conditions.

The transfer of the compressor motor from the main generator to the auxiliary generator and vice versa is controlled automatically without attention from the operator. A compressor governor operates to cut off power to the compressor motor when full reservoir pressure is attained, eliminating losses in power incurred when the compressor is driven directly from the engine and unloaded.



The trucks are of special "three point suspension" design with eliptic springs over the journal boxes and cross equalization at one end

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TEN CENT PAY CHECK. Ed English, conductor on the Canadian National at Winnipeg, Man., still has an uncashed pay check which he received from the company when he first became a conductor in 1913. It is for 10 cents. In those days conductors had to buy their own uniforms; that is, they were supplied by the company but the cost was taken out of the conductor's first pay check. The sum of one dime was all that was coming to Conductor English on February 15, 1913, when the cost of his uniform was deducted.

Aerodynamics of the Railway Train

By Alexander Klemin*

Part II—Head-on air resistance for locomotives and trains—A survey of the wind-tunnel experiments which have already been made.

WE have seen that for a flat plate there is positive pressure at the front of the plate and negative pressure in the rear. From analogy with this distribution of pressure, it has been proposed that the total air resistance should be divided into (1) form resistance due to front positive pressure and rear suction, and (2) skin friction.

It is not practicable to make such a subdivision particularly for an unstreamlined train. Even for a streamlined train, it would be extremely difficult and involve a great deal of experimentation to separate the form drag from the skin friction. Particularly in the early stages of the art, it seems better to find total drag coefficients from wind-tunnel measurements.

For a long train a formula of the following character has been proposed:

$$K = K_0 + K_1 + K_2 \ldots\ldots\ldots + K_n$$

Where K_0 = coefficient of the locomotive, and K_1 K_2 $\ldots\ldots\ldots$ K_n = the coefficients of the n coaches.

A simpler formula is

$$K = K_0 + (n\text{-}1)\ K_1 + K_n$$

Where K_1 = the coefficient of a coach intermediate between the locomotive and the last coach.

A more satisfactory formula probably would be:

$$K = K_0 + K_1 + (n\text{-}2)\ K_2 + K_n$$

where K_1 = coefficient of first coach.
K_2 = coefficient of an intermediate coach.
K_n = coefficient of the last coach.

Such formulæ should be used with caution, particularly for short trains. In a short train the addition of another coach does not simply add the side or skin friction resistance but modifies appreciably the "fineness" of the train, that is, the ratio of length to width or breadth and so the whole character of the flow. In airship work resistances are investigated in relation to fineness ratio, but no simple formula of the above character has been developed. It is probably only for quite long trains that the last formula given above would be valid.

Wind Tunnel Tests of Single Rail Cars

1—New York University Test of a Conventional Rail Car and a Jaray Streamline Car.[1]

A single conventional railway carriage 35 in. long, 4.938 in. wide, 7⅛ in. high 1/23.6 scale with exposed wheels, smooth surfaces, and no ventilators, windows or projections represented, (see Fig. 1), when tested at 54.3 m.p.h., gave an engineer's coefficient of resistance of .00134 on the projected area of the car.

A Jaray streamline car (see Fig. 2) tested at the same speed, had a coefficient of .000591. These tests were made in the presence of a ground board, suspended just underneath the wheels of the car, but a velocity survey was made in the vicinity of the ground, and an average value of the velocity was employed in calculating the resistance coefficient.

2—Lay's Test on a Box with Rounded Corners and Exposed Wheels[2]

Lay's test on a box 25 in. long, 9 in. wide, and 8 in. high with wheels exposed, smooth surface and no projections (see Fig. 3) was made by the mirror method at speeds between 30 and 70 m.p.h. The average value of the coefficients K were as follows.

	K
a—Rectangular box, sharp corners and edges, with wheels.....	.00220
b—Rectangular box, sharp corners and edges, without wheels.....	.00219
c—Rectangular box, 6 in. radius, corners and edges with wheels...	.00151
d—Rectangular box, 6 in. radius corners and edges without wheels	.00146
e—Rectangular box, 9 in. radius, corners and edges with wheels....	.00118
f—Rectangular box, 9 in. radius, corners and edges without wheels	.00113

3—Tietjens Test of a Single Interurban Car[3]

The tests were made by the mirror method. Neither the size of the models nor speed of tunnel test are avail-

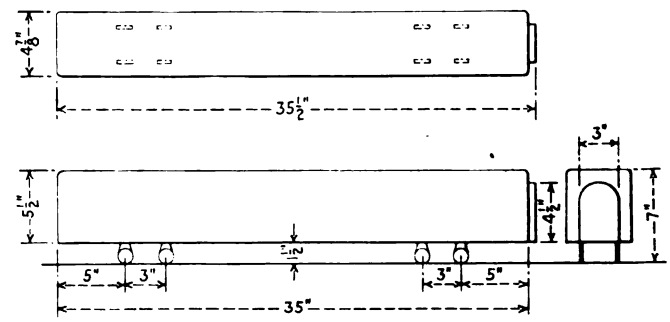


Fig. 1—Model of a conventional railway carriage as tested at New York University

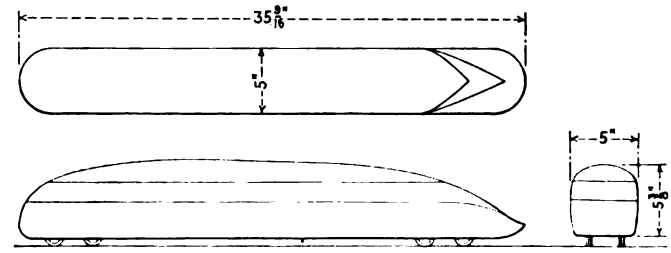


Fig. 2—Jaray streamlined car

* Professor in charge of the Daniel Guggenheim School of Aeronautics, New York University, New York.

[1] Unpublished report, permission secured to quote.

[2] Fifty Miles per Gallon with Correct Streamlining, W. E. Lay, S.A.E., January, 1933.

[3] O. G. Tietjens and K. C. Ripley, Air Resistance of High-Speed Trains and Interurban Cars, Transactions of the A.S.M.E. Applied Mechanics, September 30, 1932. See also *Railway Mechanical Engineer* for January, 1932, page 18.

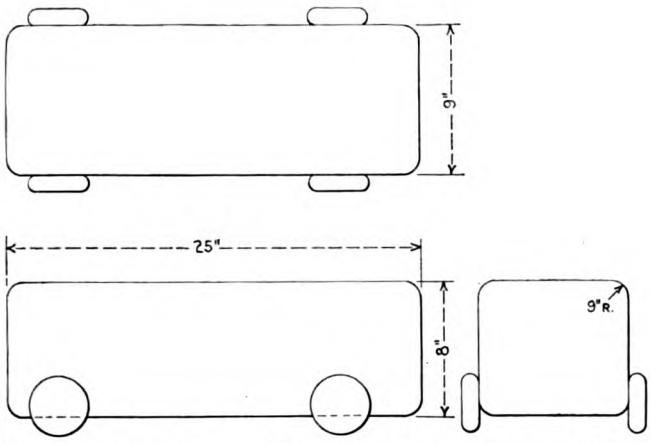


Fig. 3—Box with rounded corners and exposed wheels as tested at University of Michigan

able, although the scale is stated to be 1/25, with projected area of 83 sq. ft. for the full car and a weight of 25 tons. The models are shown in Fig. 4. The coefficients of resistance obtained in four tests were as follows:

	K
No. 1—Perfectly streamlined car	.000204
No. 2—Same as Car No. 1 but same in rear as in the front for two-way operation	.000306
No. 3—Same as No. 1 with streamlined front, rear and roof, but with windows and underparts of the present type car	.00046
No. 4—Present type car	.00127

The resistance of the "perfectly" streamlined car is noteworthy. From comparison of coefficients for Models No. 1 and No. 2 it is seen that the advantage of the narrow tapered tail is quite marked. The high value of Model No. 3 indicates the importance of flush windows and of enclosing wheels.

4—Leboucher's Tests on Some French Rail Cars[4]

The French Midi Railway was one of the first to decide to use light rail motor coaches, and carried out some interesting experiments in the wind tunnel at Issy-les-Moulineaux in November, 1931. See Fig. 5.

Model A constructed to a scale of $\frac{3}{100}$ consisted of two ends, front and rear, which are symmetrical and a central cylindrical portion divided into six equal and detachable sections. With the aid of the detachable

[4] Leboucher, Aerodynamical experiments on the exterior form to be given rail motor cars (Engineering Societies Library, New York City).

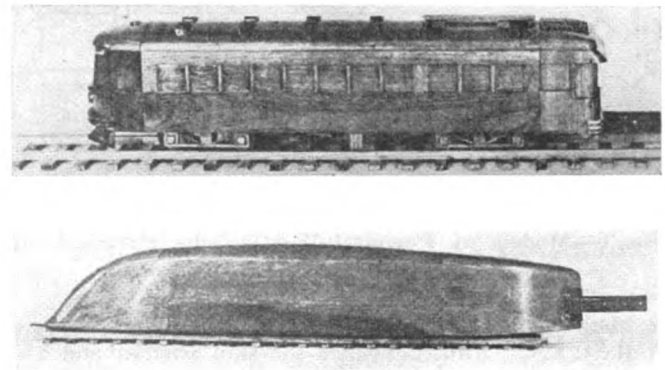


Fig. 4—Models of a present type and a streamlined interurban car

sections it was possible to reproduce rail coaches of different lengths varying from 43 ft. 4 in. to 76 ft. 1 in. The rail car was designed with a central raised driving compartment represented by a cup shaped projection with either a rectangular or elliptical base. It was found that the resistance of the central raised driving compartment was so large that its use was impracticable. The influence of length increase was found to be negligible. The value of K was approximately .00078.

Model B was tested by the mirror method. This model had symmetrical faired ends but the same width throughout its whole length. The value of K was .00088.

Model C was faired in plan form but not in elevation. The coefficient K was considerably less, namely .00039.

Model D had a rounded bow and a definitely "airship" form in plan. The lowest value of K for the series was obtained, namely .00028.

While the shape of these cars does not make them suitable for American practice, the results are interesting as they tend to show that fairing in plan, as well as in elevation, is helpful.

5—St. Louis Tests

Important tests were made on a type of car commonly used in electric railway service by the Electric Railway Test Commission at St. Louis in 1906. Dynamometer measurements were made of the pressure on the front

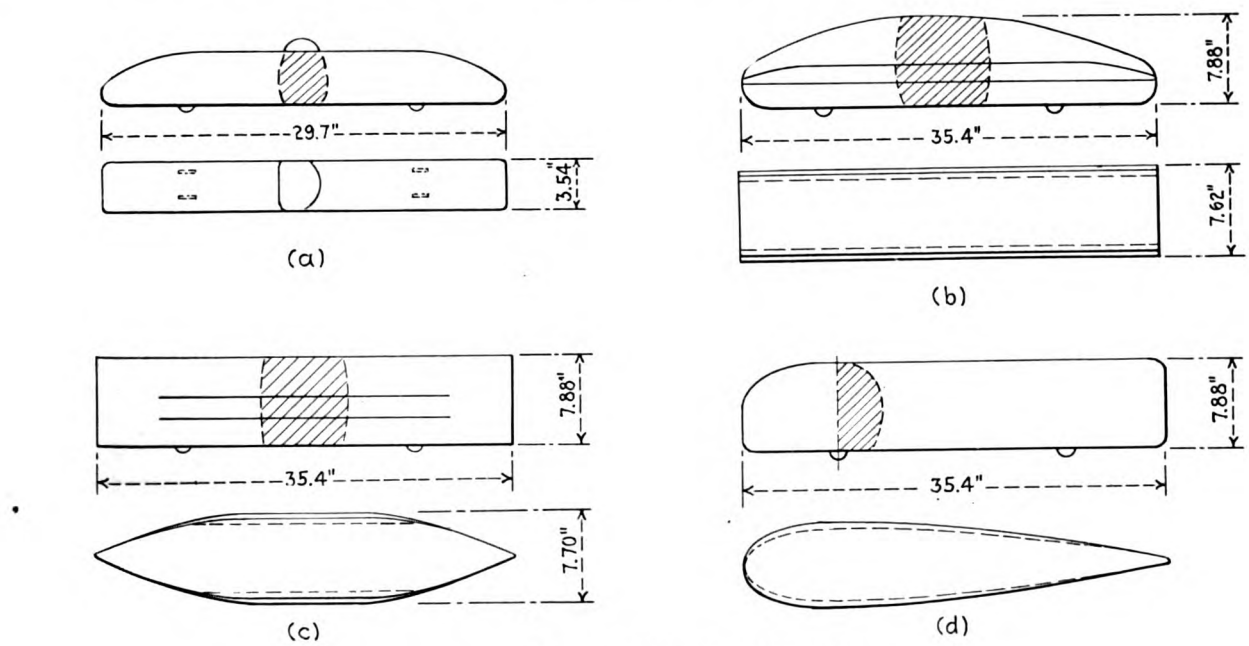


Fig. 5—Leboucher's models

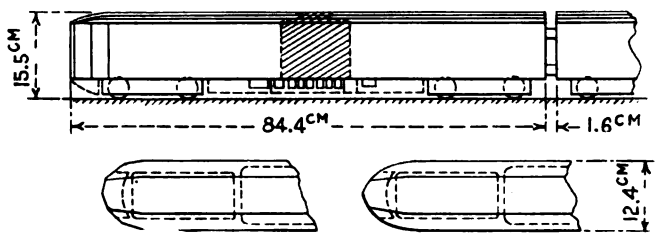


Fig. 6—Models of Rheinisch-Westfälische electric-train tests

vestibule and suction on rear vestibule. From analysis of these tests, with allowance for skin friction and assumption of equal pressure effects for trucks by W. G. Davis, Jr.[5], the following results are available on a basis of 60 m.p.h.

Shape of vestibule	Flat	Standard	Parabolic	Parabolic Wedge
Total pressure and suction (measured) resistance, lb.	835	535	263	245
Skin friction, lb.	47	47	47	47
Total resistance for car, lb.	882	582	310	292
Cross-sectional area of car alone, sq. ft.	72	72	72	72
K for car alone	.0034	.00225	.00120	.00113
Cross-sectional area of truck, sq. ft.	16	16	16	16
Resistance of truck (estimated), allowing 19 lb. for bottom of car, lb.	205	138	78	73.5
Total resistance of complete car, lb.	1087	673	341	318.5
Cross-sectional area car body and trucks, sq. ft.	88	88	88	88
K for complete car	.00340	.00212	.00108	.00101
K complete car, on car area alone	.00415	.00260	.00137	.00124

Westinghouse Tests on an Electric Train with a Small Number of Coaches[6]

Tests were made by the mirror method on a model of an electric locomotive alone and with one and two coaches for both an ordinary and a streamlined train.[7] The following table has been compiled from the curves in Tietjens and Ripley's papers in which a straight line extrapolation was made to trains of six coaches, because practically no difference could be detected in the air resistance of the first and second coaches in either of the train models. The projected area of the coaches is given as 126 sq. ft., and the resistance coefficients were apparently referred to this area.

	K Ordinary train	K Streamline train
Electric locomotive alone	.00204	.0009
Electric locomotive and one coach	.00306	.00128
Electric locomotive and two coaches	.00408	.00164
Addition to K per coach	.00102	.00038

[5] W. J. Davis, Jr. The Tractive Resistance of Electric Locomotives and Cars, General Electric Review, October, 1926.
[6] O. G. Tietjens and K. C. Ripley loc. cit.
[7] See *Railway Mechanical Engineer* for January, 1932, pages 18 and 19, Figs. 2 and 3.

The reduction in resistance by streamlining is very large.

Rheinisch-Westfälische Schnellbahn Tests

Experiments were made in the Göttingen wind tunnel[8] on two high speed electric coaches for the "Studiengesellschaft für die Rheinisch-Westfälische Schnellbahn." The models tested are shown in Fig. 6 where dimensions are given in centimeters. The scale of the models was 1/25 and they were built of wood. Such details as door handles, window projections, etc., were omitted. The front and rear car were of the same construction and were coupled together with a wooden dowel. The mirror method was employed. The cross-sectional area of the model was 160 sq. cm.

Description of Model	K
Model Ia—Without end cover or box enclosing accessories	.00128
Model Ib—With end cover and no box enclosing accessories	.00123
Model Ic—Without cover and with box enclosing accessories	.00110
Model Id—With end cover and box enclosing accessories	.00105

The two trains had an excellent coefficient of resistance to start with and the streamlining effects introduced were therefore slight.

The effect of submitting a round head for the sharp cornered head was found to be negligible, but the following experiments were of interest.

Description	K
Model Id	.00105
Model Id—With space between cars covered in	.00100
Model IId—Round head substituted for sharp-cornered head in front car	.00100
Model IId—With both cars equipped with rounded heads	.00128

Closing in the space between the two cars does not seem to affect the resistance very much; but providing both cars with rounded heads is seen to have quite a detrimental effect.

Tests of the Union Pacific Train

The tests were made at New York University[9] and the models employed are illustrated in Figs. 7 and 8. These models built by the Pullman Car & Manufacturing Company to a scale of 1/30 were of three-car trains. Train No. 1 consisted of a power car with an intermediate car and a tail car, with total length of 75 5/8 in. With this model three interchangeable cabs were sup-

[8] Ergebnisse der Aerodynamischen Versuchsanstalt zu Göttingen III Lieferung, page 161.
[9] Unpublished report, permission secured to quote.

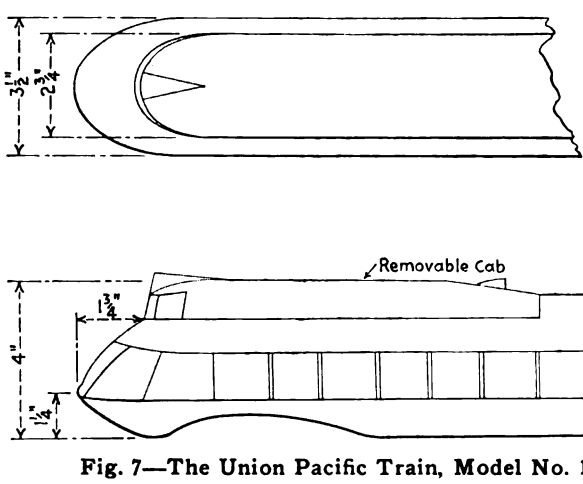


Fig. 7—The Union Pacific Train, Model No. 1

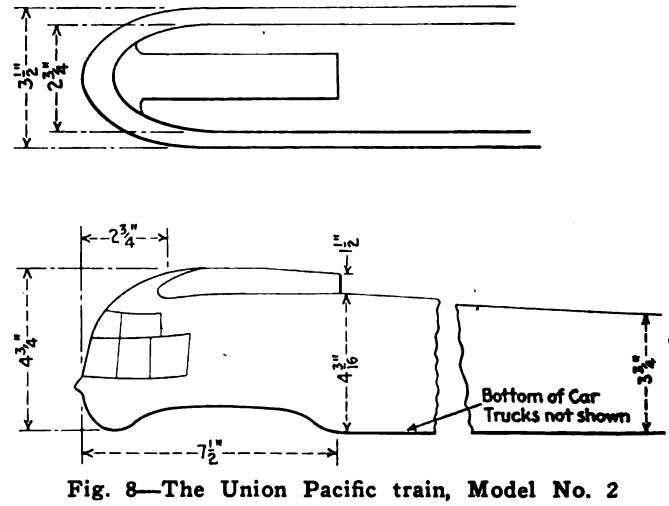


Fig. 8—The Union Pacific train, Model No. 2

plied. The cab with rounded nose, headlight and smoke top was designated as cab No. 1. The cab with headlight, nose consisting of five flat windows and a radiator on the top was designated as cab No. 2. The cab with rounded nose, no headlight and a radiator on the top was designated as cab No. 3. On top of all three cars of train No. 1 small projections representing ventilators were included. The tail car of this train tapered to a narrow section which was rounded at the extreme rear end. The nose car of train No. 1 was rounded in side view. From the rear end of the cab to the end of the front car the cross-section was constant.

Train No. 2 of a length of 74 in. consisted of a power car, an intermediate car and a tail car. In this model, no interchangeable parts were available. The nose of the power car was rounded in plan view, but quite blunt in side view. The cross-section of this car gradually tapered from a depth of $4\frac{3}{16}$ in. behind the cab to a depth of $3\frac{1}{4}$ in. at the rear of the car. The tops of the cars in this train were smooth, no ventilators being represented. The tail car had a tapering rear section but did not taper as sharply as train No. 1.

The cross-sectional area of the intermediate car was 11.5 sq. in. in both trains and all computations for the drag coefficient were referred to this area.

The coefficients obtained were as follows:

	K
Train No. 1, Cab. No. 1	.000887
Train No. 1, Cab. No. 2	.000963
Train No. 1, Cab. No. 3	.000887
Train No. 2	.001038

Train No. 1 had lower drag coefficients with all three different cabs. This is probably due to the better streamline shape of the nose and to the more highly tapered tail. Of the three cabs tested with train No. 1, cabs No. 1 and No. 3 show the same drag coefficient but cab No. 2 gives a higher value. Cab No. 1 appears cleaner aerodynamically as it had a smooth top, but the frontal area of No. 3 is less than that for No. 1. Evidently these two factors tended to counteract each other with the same drag values as a result.

Berlin Experiments on End Effects

Tests were made at the Berlin Technische Hochschule on end effects (front and rear). The models and suspension in the wind tunnel are shown in Fig. 9. The ground board method was employed. The models consisted of a single complete coach and two half coaches, connected so as to form a single block. Fixed ends *a* and *b* were held rigidly in position with metal cover plates *c* permitting the models to swing slightly on the balance without discontinuity of the entire set-up. The end pieces were so designed as to give the least possible excess of velocity above the velocity of the undisturbed air stream. Not all the excess velocity was avoided however. It may be surmised that there is a slight forward suction effect due to the air spaces at *c*, but this is more or less balanced by the greater resistance due to excess velocity. Hence the true side and skin friction resistance of the coaches is obtained approximately. The procedure is analogous to that employed in measuring the skin friction of a flat plate. By removal of the rear end piece *b* and of the rear half coach, information was obtained on the increased resistance of a coach when used as a tail coach.

The coaches tested are shown in detail in Fig. 10. Models 1 and 2 are "D-Wagen" of the German State Railroad, of the latest type and Model 3 corresponds to a new type employed by the French Nord Railroad. The models were smoothly constructed in wood without windows, doors, ventilators, etc. With Models 1 and 2, normal and oversized interconnecting corridors were employed to determine the resistance of the trucks, the

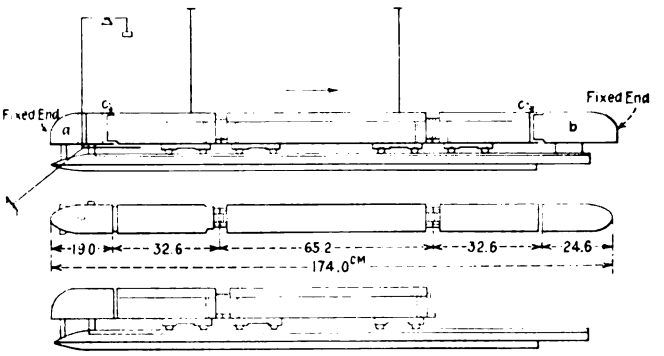


Fig. 9—Models and suspension for tests at the Berlin Technische Hochschule

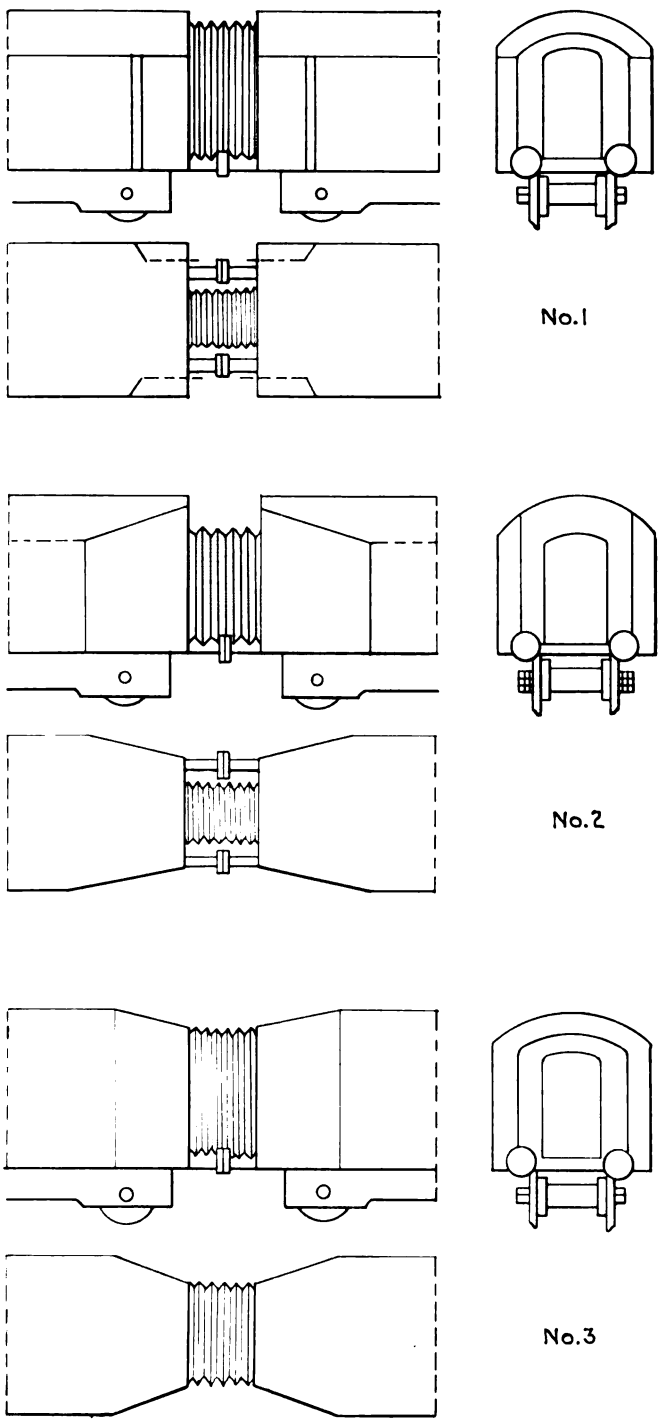


Fig. 10—Details of models tested at Berlin Technische Hochschule

coaches were also tested without running gear.

Such a test is not, of course, entirely valid from an aerodynamical point of view.

The tests were made at various wind speeds and a definite scale effect was observed. In the appended table of results, apparently the values obtained at highest tunnel speed were used. The equivalent areas given in this table need explanation. German writers very frequently refer resistances to an equivalent area on which the entire dynamic pressure, $\frac{\rho v^2}{2}$, is exerted; we must convert to our usual coefficient K as follows:

$$R = \frac{\rho v^2}{2} A_e = K V^2 A$$

$$\text{So that } K = \frac{\rho 1.467^2}{2} \times \frac{A_e}{A}$$

Where A_e = equivalent area in sq. ft.
A = actual projected area in sq. ft.

In the table such a conversion has been made. On the basis of data submitted by the staff of the *Railway Mechanical Engineer,* the projected area has been taken as 110 sq. ft.

From the table these conclusions may be drawn.

1. There is an appreciable difference in resistance—some 7 or 8 per cent between the "smooth" carriage and the one in which windows, ventilators, etc., are represented.

2. The truck resistance is a surprisingly large proportion of the whole resistance.

3. Comparatively small changes in design of coach ends may have an appreciable effect on the resistance. Thus Model 3 with the large intercommunicating corridor, and careful fairing into the corridor has only 69 per cent of the resistance of Model 1 with normal corridor. Without going to extreme departures from current practice quite worth while resistance reductions may be achieved.

4. The end effect is appreciable. Without the shelter of the tail piece, the increase in resistance of the last coach may be of the order of 50 per cent.

While Tietjens tested by the mirror method, and Vogelpohl by the ground board method (which is apt to give low values of resistance) yet Vogelpohl's tests check remarkably with full scale tests. Also Vogelpohl adopted a much more rational method of testing for the resistance of a single intermediate or end coach—though he would have done better to have had a locomotive shape at the front end.

Results of Tests at the Berlin Technische Hochschule

End or intermediate coach	Model	Type of interconnecting corridor	Equivalent area in sq. meters = F	Projected area in sq. ft., estimated	K = F(.00025)
As end coach	Model with windows, ventilators, etc.	Normal	2.44	110	.00061
As end coach	Model 1 smooth	Normal	2.28		.000578
As end coach	Model 2 smooth	Normal	2.15		.000540
As end coach	Model 3 smooth	Large	1.75		.000438
As intermediate coach	Model 1 with windows, ventilators, etc.	Large	1.88		.000470
As intermediate coach	Model 1 with windows, ventilators, etc.	Normal	1.73		.000433
As intermediate coach	Model 1 smooth	Normal	1.53		.000373
As intermediate coach	Model 2 or 3 smooth	Normal	1.69		.000423
As intermediate coach	Model 3 smooth	Large	1.20		.000301
Truck			0.58		.000145

His values for intermediate coaches though so much smaller than Tietjens' are a more reliable guide to computations.

Other experiments at the Berlin Technische Hochschule reported briefly in Z. V. D. I.[10] indicated that the resistance of an ordinary locomotive could be reduced by some 22 to 23.5 per cent by streamlining. The addition of a complete cover between coaches was found to be very beneficial. Smoothing out of windows, doors, gangplanks, etc., was found to be very helpful. A large tail piece on the rear car diminished the resistance of the entire train by 5 to 7 per cent.

[10] G. Wiens, Neuerungenim Personenwagenbanales Deutschen Reichsbahn. Z.V.D.I., April 1, 1933.

[*Part III will conclude the survey of existing wind-tunnel data and will interpret air resistance in terms of horsepower under various conditions.—Editor.*]

Worthington Type SA Feedwater Heater

THE Type SA locomotive feedwater heater equipment made by the Worthington Pump & Machinery Corporation, Harrison, N. J., is similar to the Type S, but differs from it in certain details, as all three essential parts have been redesigned and improved to secure added efficiency, dependability and economy. In these open-type heaters cold water from the tender is sprayed into the heating chamber where it contacts with exhaust steam from the locomotive cylinders. As the feedwater is heated, oxygen is driven off and escapes through the air vents to the atmosphere.

The equipment consists of three distinct units—the cold-water pump, the heater and the hot-water pump. These independent units are comparatively small and can be located to the best advantage for weight distribution, maintenance convenience, and appearance of the locomotive. The units are shown, diagrammatically arranged, in the illustration.

Cold water from the tender is supplied to the heater by a variable-speed turbine-driven low-pressure centrifugal pump located on the side of the frame near the tender. The steam turbine drives the pump at a speed necessary to deliver the amount of cold water required. The heater is set in the smokebox, either in front or back of the stack. Locomotive exhaust steam passes into the exhaust inlet at the bottom of the heater and through the exhaust check valves to the heating chamber, where it contacts with the cold water which has been forced through the spray valve by the cold-water pump. The heated water flows down through the hot-water outlet to the hot-water pump which delivers it to the boiler. The water level in the heater is controlled by a float-actuated control valve which regulates the speed and capacity of the cold water pump by varying the steam supply to the turbine. The hot-water pump is of the horizontal reciprocating type. It is located as close to the heater and the boiler check valve as practical.

The type SA equipment has a drifting control valve attached to the steam chest of the hot-water pump. This valve is operated by the pressure in the steam pipe or steam chest of the locomotive. When the locomotive throttle is closed or in the drifting position, this valve automatically reduces the quantity of steam for operating the pumps, thus limiting the amount of water fed to the boiler. The pumps will automatically speed up again when the locomotive throttle is opened. The drifting control valve relieves the engineman of the necessity of closing the pump-operating valve when drifting or making short stops.

The Type SA equipment is furnished in three sizes having capacities of handling 6,600, 9,000 or 12,000 gallons of water per hour.



Putting "Pep" in The Organization

An Employees Magazine Editor, in a chat with the Editor, emphasizes the importance of the Mechanical Department in developing a strong family spirit

IT is difficult to sum up in a short paragraph the various reasons advanced for the establishment of railway employee magazines. One group will emphasize the importance of developing a strong family spirit within the organization so that each department will co-operate more intelligently and enthusiastically with the others in promoting the interests of the railroad as a whole. Others will emphasize the importance of inspiring and encouraging the employees to use their influence in securing freight and passenger business for the railroad—in other words, to stimulate the activities of booster clubs or similar movements. Certainly it is no easy task to induce an enthusiastic spirit of teamwork in a large organization, thinly spread over a great area.

Recent years have been difficult ones for employees magazines in industries and organizations generally, as well as on the railroads. Many of these publications have been wiped out of existence; others have been greatly reduced in size. That they have survived at all is a tribute to the value placed upon them by the managements. As business has picked up, some of the discontinued magazines have been revived, and those which have continued publication have been enlarged and strengthened.

About 25 per cent of the employees of a railroad are included in the mechanical department. Congregated in considerable numbers at important repair shops and engine terminals, they can be a most important factor in representing the railroad in the local communities, both in assisting to interpret its problems to the public and in soliciting business and support. The railway employees' magazine, properly edited and distributed, can do much to educate and inspire the employees to use their best efforts in these directions.

There are, of course, considerable differences of opinion among the editors of employees' magazines as to the kinds of articles that should be used, and this is particularly true in times such as these when most of the publications are forced to operate on minimum budgets. Much stress is placed on the intimate personal notes and local news items from correspondents at important points. Most of these magazines include articles concerned with the relations between the railroad and the public, as well as interesting information about points of special interest on the railroad. Some of the magazines play

*Fourteenth of a series of interviews with men outside the mechanical department, commenting in a constructive way upon the possibilities of that department.

up records of all sorts in the effort to stimulate a friendly competitive spirit throughout the organization. Occasionally excellent articles will be found, giving information about new and unique equipment and facilities.

How Mechanical Department Can Co-operate

With these facts as a background, I approached the editor of one of the railroad employees' magazines with this question: "How can the mechanical department co-operate with you in your efforts to strengthen the magazine and make it of greater interest to the employees as a whole?"

"First," replied the Editor, "let me say that we receive splendid co-operation from our correspondents generally, and particularly from those at shop points, who usually come through with excellent material about the personnel and local happenings.

"Our great difficulty," he continued, "is to get well-illustrated news items and articles about important improvements in equipment and facilities, and of unusually good records either in the operation of the equipment on the road, or concerned with the output of the repair shops and engine terminals."

"Do you really find," I asked, "that your readers in other departments are interested in mechanical details, such as might be included in the sort of articles you mention?"

"Yes," replied the Employees Magazine Editor. "In the first place, you must remember that about 25 per cent of the railroad employees are in the mechanical department. Many of those in other departments, however, have to do with the operation and use of the equipment and they are greatly interested in knowing what sort of improvements are being made and how they will be reflected in improving the service, or in making it possible to operate with greater efficiency and economy."

Cites a Specific Instance

"Can you give me an illustration to support this statement?"

"Yes," replied the Employees' Magazine Editor. "Recently we incorporated an improvement which was most noticeable in the exterior appearance of the locomotives which draw our crack passenger trains. We received several inquiries as to the purpose and intent of this device. We would have made a real hit with these people, and many others, as well, if we had been tipped off in advance and had been able to make a suitable announcement in the columns of our publication.

"Another illustration of the failure of the mechanical department to co-operate with the editor of the Magazine occurred recently. My attention had been directed to two new developments in motive power, each of them promising something interesting and perhaps significant. My informant was not even a railroad man, but a passenger interested in things mechanical. I immediately instituted inquiry with the mechanical department about both developments and got the customary answer—that both were experiments and that in due time we would be advised concerning how they were working out. Imagine my surprise a couple of months later to be sent two clippings from my passenger friend. Both were from a recent issue of an English railroad magazine, and covered the two experiments in detail."

"Is this due to indifference on the part of the mechanical department officials," I queried, "or is there some special reason for lack of co-operation?"

Lack of "News Sense"

"In the first place," replied the Editor, "our mechanical department friends apparently fail to realize how much the employees of the mechanical department and others, as well, are interested in information of this sort. They do not recognize the extent to which it stimulates pride in the road because of its accomplishments and its progressiveness. Frankly, I suppose we can ascribe it to a lack of 'news sense' on the part of these officers.

"Sometimes I know," he continued, "that the unwillingness of mechanical department officers to release information about new developments is because they, too, are under wraps. In other words, they have been told by the management to keep quiet about what they are doing, and they have no alternative. In cases like this I have sometimes received my first information about new developments from shopmen whom I have met about town, or on a trolley car. And, then, of course, the new developments are no longer a secret, even if the editor can say nothing about them in his Magazine."

"Are you doing your part to assist in developing a 'news sense' in the mechanical department?" I asked. "Isn't it asking a little too much to expect officers busy with technical affairs to keep this matter foremost in their minds?"

"Apparently we have failed badly in this," replied the Editor, "but we do take every possible opportunity to interest these officers in the kind of material that we would like, and naturally we go directly to them if we get tips about new developments. With our limited staff and facilities, however, it is quite impossible for us to keep up with these improvements and we are sorely in need of more real help and co-operation."

"Is it not true," I asked, "that in some instances it may not be advisable to mention improvements which are being made in the nature of trials or tests?"

"Possibly that is true," replied the Editor, "but looking back over the years, I think I can say with some emphasis that there has been too much conservatism in that respect. As I see it, for instance, the new high-speed, streamlined trains are in the nature of an experiment. Whether they succeed in their present form or not, the very fact that they have been built and placed in operation has attracted widespread favorable attention in this country and throughout the world. The public is impressed with the fact that the railroads are alive and progressive, and that they are willing to take the initiative in trying out new ideas which may help to strengthen them and regain business which has been lost to other types of carriers. I heard an officer of one of these railroads say the other day that they had already secured so much favorable publicity from one of these trains that they could afford to throw it into the ocean and forget about it, if it did not make good to the degree that they had anticipated.

Give Employees Something to Talk About

"It seems to me," continued the Editor, "that you can apply the same principle to articles concerning new devices or new methods and practices which may be published in the employees' magazines. Give the employees something to think and talk about! It will indicate a spirit of progressiveness and virility on the part of the railroad and in many instances will inspire the employees to boost the road in talking with their friends and neighbors."

"You appear to feel rather strongly on this subject," I ventured. "Have I touched a sore spot?"

"Yes, and no," replied the Editor. "I was a bit chagrined the other day when I saw a story in the newspapers about certain new developments in our passenger

equipment that we knew nothing about. In other words, the newspapers 'scooped' our magazine, although the nature of the improvement was such that it is of special interest to our employees. Moreover, it is something that they can use to excellent advantage as a talking point in their efforts to build up good-will for the railroad, with a view to securing business."

"What other kind of articles can the mechanical department give you that will be of special value in assisting you to stimulate a greater interest on the part of the employees?"

"A lot of good records are being made in different departments, or at different points on the road, which would be a real inspiration to our employees, and in many instances would stimulate a healthy and friendly competition on their part. It may be asking too much to expect that these matters will automatically be sent to our office. They do, however, mean so much to the welfare of the railroad as a whole that I wish someone in every department and at every important point on the railroad could be definitely assigned the task of sending such material to us. I have about come to the conclusion that we cannot expect the right sort of co-operation except from people who have some 'news sense' about the value of these particular things, and who will have that 'news sense' stimulated by the fact that the task of getting certain material to us has been quite definitely assigned to them. I am thinking now not of our regular correspondents, but rather of staff specialists who can co-operate with us."

"Is there any question of responsibility or censorship involved?" I asked.

"Yes," replied the Editor. "Which leads me to say that I do wish these men could also be given sufficient authority so that the material would not have to be routed around over several desks before it reaches us. I realize the necessity, of course, of having someone in authority check over the advisability of our publishing material of this sort. It is surprising, however, how many good things have been buried in this process, or if they have finally wiggled through, have been so delayed that the news value was largely lost. If they could realize how much these things can be used to stimulate and inspire the organization as a whole, I feel quite sure that some of our officers would be less conservative in their attitudes, knowing full well that the road in most cases stood a chance of gaining far more than it could possibly lose by a more liberal policy on their part.

Brake and Draft-Gear Action During Emergency Applications

By O. R. Wilkander*

Simple formulae for relationship between travel and capacity of draft gears, car length and mass, and speed of propagation of air-brake emergency applications are derived from a mathematical analysis of the wave action in long freight trains

WHILE it has been recognized that a certain interdependence exists between air brake and draft gear action the nature of this relationship has remained rather obscure. In an effort to throw some light on this subject the mechanical processes involved have been analyzed for certain ideal conditions and the results obtained have led to the formulation of a few simple rules governing said relationship. Omitting the mathematical analysis, the main rules will be given which have been derived therefrom and these rules will be checked by such test results as are available.

Coupler Pressures and Tensions

The object of emergency braking is to stop the train in the shortest possible distance. For this reason the air brakes should be applied as quickly and effectively as possible and the draft gears should be strong enough to cushion the resulting car impacts without going solid.

The application of the brakes begins at the front end of the train and proceeds with short intervals from car to car, under the influence of reduction in brake pipe pressure, throughout the train. The speed of brake application should, of course, be as high as possible in order to obtain a quick stop. The progressive brake applications generate coupler pressures between adjacent cars beginning at the front end where a coupler pressure is created between the first and the second car and, progressing throughout the train, a higher pressure is created between the second and the third car, a still higher one between the third and the fourth car, etc., until this pressure reaches a maximum value somewhere in the rear part of the train. From there on the coupler pressure decreases either gradually and uniformly, or rather abruptly towards the end of the train, depending on the characteristics of the brake equipment and on those of the draft gears.

During the formation of these coupler pressures the car speeds become equalized and all cars in the train attain a certain uniform speed at the time said coupler pressures reach their maximum values. These coupler pressures tend to accelerate the front end and retard the rear end of the train, creating a higher speed at the front than at the rear end. This difference in car speed will stretch the train and will gradually change the coupler pressures to coupler tensions. Said tensions appear at first at the rear end of the train between the last and the second last car, then between the second and third last car, the tension at that point being higher than that between the last and second last car. The tension between the third and fourth last car is higher still, and so on until the maximum coupler tension is created at some point towards the front end of the train in the same way as the

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maximum pressure was created somewhere towards the rear end. The coupler tensions thus created are much smaller than the coupler pressures which created them due to the dampening effect of the energy absorption in draft gears, car bodies and lading.

The period of coupler tensions is followed by a second period of coupler pressures which, however, as a rule are very feeble and thus of negligible influence on the action of the train. It is thus seen that the progressive brake application creates a pressure wave which, periodically changing into a tension wave, passes back and forth through the whole length of the train until completely dampened by the energy absorption in the draft gears, the car bodies and the lading. If, and as long as, the draft gears yieldingly resist this wave without going solid the created coupler pressures and tensions will be kept within moderate limits and will not cause any serious damage to the equipment. If on the other hand the draft gears are not strong enough to withstand the pressures created by the said wave, they will be closed solid by the first pressure wave and the otherwise moderate pressures will rise to destructive values and may cause telescoping of the cars and derailment of the train.

It is thus important that the characteristics of the draft gears be adapted to the intensity of the brake action so as not to go solid. A mathematical analysis indicates that the greatest coupler pressure, which can be created at any point in the train under any conditions of car loading, draft gear and air brake characteristics, provided that the draft gears do not go solid can be computed as follows:

Let:
F = maximum retarding force in pounds per car during emergency brake application.
n = number of cars in train.
P = maximum possibly occurring coupler pressure in pounds.
q = draft gear travel in feet.
C = minimum required draft gear capacity in foot-pounds.

The minimum capacity of a draft gear which will permit emergency braking of a train under all speed and load conditions without closing any one of the gears is determined by the formula

$$C = \frac{Fnq}{4} \quad \ldots\ldots (1)$$

The maximum possibly occurring coupler pressure is the reaction of the gear when subjected to an impact of the same magnitude as the capacity C.

If the characteristics of the draft gear are such that it compresses from zero to its maximum travel in proportion to the applied pressure, the maximum occurring coupler pressure will not exceed the value

$$P = \frac{2C}{q} \quad \ldots\ldots (2)$$

or, inserting the value of C from equation (1) in equation (2) the maximum coupler pressure would, under the stated conditions be:

$$P = \frac{Fn}{2} \quad \ldots\ldots (3)$$

The formula (1) expresses the fundamental rule for the relationship between draft gear capacity and braking force and can be worded as follows:

In order positively to prevent the draft gears from going solid during a brake application under all load and speed conditions, *the capacity of the draft gear should be equal to or larger than 25 per cent of the product of the maximum retarding force per car, times the number of cars in the train, times the travel of the gear.*

If this condition is not met, there is always danger that, for certain load and speed conditions, the draft gears will go solid during braking and destructive forces may develop during the first pressure wave and even during the tension wave which follows it. If, on the other hand, the above condition is met, the compression forces will always be moderate and, if draft gears of a fair amount of absorption are used, the tension forces which follow them will not be destructive to equipment and lading.

Car Retardations

The retardation to which a car is subjected during emergency brake application depends on its mass and its retarding force. The latter depends on the braking force acting on the car as well as on the difference between the two coupler forces acting on it. This difference is largest if the characteristics of the draft gears and air brakes are such that the maximum coupler pressure abruptly drops from its maximum value to zero, in which case this total pressure, in addition to the braking force, acts as the retarding force on the mass of one car.

The operating conditions, under which such a sudden drop in coupler pressure occurs are defined by the following relationships.

Let
L = length of one car, from coupler to coupler in feet.
v_1 = speed of air brake propagation in feet per second.
M_1 = critical mass of car or the mass which will cause an abrupt drop of the maximum coupler pressure.
a = maximum car retardation in feet per second per second.

Such sudden drop of coupler pressure occurs if and when:

$$M_1 q^2 v_1^2 = L^2 C \text{ or}$$

$$M_1 = \frac{L^2 C}{q^2 v_1^2} \quad \ldots\ldots (4)$$

and the corresponding maximum car retardation is

$$a = \frac{P + F}{M_1} \quad \ldots\ldots (5)$$

or if the characteristics of the draft gears are such that the value of P from formula (3) can be applied, it is

$$a = \frac{F(n+2)}{2M_1} \quad \ldots\ldots (6)$$

It will be seen from formula (6) that the value *a* decreases with increasing values of M_1 and, in order to obtain a low retardation, the mass of the car, for which this abrupt drop of coupler pressure occurs should be as great as possible, preferably greater than that of the fully loaded car so as to completely avoid this undesirable condition.

Referring to equation (4) it will be seen that only q and C are dependent on the draft-gear characteristics and that the mass M_1 increases with increasing values of C and with decreasing values of q. High draft gear capacity and short travel are thus desirable in order to decrease the maximum car retardations.

Use of Above Method for Analysis of Draft Gear and Brake Action

If the maximum retarding force per car is known, the above formulae make it possible to compute the minimum draft gear capacity, which for a given gear travel and number of cars will permit safe emergency braking.

If the thus computed draft gear capacity is not available the retarding force must be temporarily reduced to such an extent that it can be applied without causing the gears to go solid and thus avoid dangerous or even destructive coupler pressures. Such a reduction in the available maximum retarding force is, of course, undesirable as it increases the minimum stopping distance of

the train and thus endangers its safety of operation.

According to the A.R.A. 1933 Specifications for Freight Brakes, Circular D.V.-803, page 11, a nominal initial brake cylinder pressure of 15 lb. is to be developed in not more than 1½ seconds and the maximum pressure in nominally 10 seconds. This delay in the application of the maximum air pressure increases the minimum stopping distance of a long train about 300 ft. and could be avoided if the draft gears were of adequate capacity, as computed from the above formulae.

In order to illustrate the application and check the validity of the above formulae a few examples will be selected from published official brake tests.

Example No. 1

A.R.A. Brake Test, Siskiyou Line, Southern Pacific. Test tank cars of the following specifications were used:

Weight of empty car.....40,000 lb.
mass M 1244
Weight of loaded car.....120,000 lb.
mass M 3732
Length of car L.....37 ft.
Draft gear capacity (including elastic action of one-half car body under the closing pressure of the gear) C=.....18,000 ft-lb
Travel of gear q plus give of one-half car body under the closing pressure of the gear.....273 ft.
Retarding force per car in lb. F=.....6000
Test No. 12202 (Series No. 101, Trial P3)
n = 100 empty cars
v_1 = 600 ft. per sec.

The minimum required draft gear capacity, computed from formula (1) would be

$$C = \frac{Fnq}{4} = \frac{6000 \times 100 \times .273}{4} = 41{,}000 \text{ ft.-lb.}$$

The actual draft gear capacity is only 18,000 ft.-lb. and thus entirely inadequate. This explains the results of the attempt to make an emergency stop from a speed of 12 m.p.h. about which the official report states that "the rear end of car No. 97 was raised off the trucks and telescoped the head end of car No. 98."

If the capacity of the draft gears had been adequate and their characteristics such that formula (3) would apply, the greatest possible coupler pressure would not have exceeded

$$P = \frac{Fn}{2} = \frac{6000 \times 100}{2} = 300{,}000 \text{ lb.}$$

which would have been entirely harmless.

The critical mass M_1 which would cause an abrupt drop of coupler pressure can be computed from formula (4).

Since this formula does not apply if the draft gears go solid C must be at least = 41,000 ft.-lb.

Assuming this capacity it is

$$M_1 = \frac{L^2 C}{q^2 v_1^2} = \frac{37^2 \times 41{,}000}{.273^2 \times 600^2} = 2100$$

The corresponding car weight is

$$2100 \times 32.2 = 67{,}500 \text{ lb.}$$

This is the intermediate load at which the maximum car retardation will occur. Computed from formula (6) it is

$$a = \frac{F(n+2)}{2M_1} = \frac{6000(100+2)}{2 \times 2100} = 146 \text{ ft./sec./sec.}$$

This is the maximum car retardation which possibly could occur in such a train if the draft gears were powerful enough so as not to go solid.

This high retardation occurs only if the mass of the car rather closely corresponds to the critical value M_1 and drops quickly to moderate values as soon as the car mass differs from said value. Furthermore, the above maximum retardation is fully attained only if the force closure diagram of the draft gear is a straight line, with the reaction proportional to the gear travel.

It is, nevertheless, desirable to select the draft gear characteristics so that the critical mass of the car falls above its usual loading range and thus keep the car retardations as low as possible. Really destructive car retardations occur, however, as a rule only if and when the draft gears go solid.

Example No. 2

It is desired to know how much retarding force can be applied per car in a 150-car train without closing the average draft gear or, in other words, to what extent must the initial braking force be reduced in such a train in order to avoid the closing of draft gears, which just meet the A.R.A. minimum requirements for certified gears.

Solving the above equation (1) for F it is

$$F = \frac{4C}{nq} \text{ in which}$$

C = 18,000 ft.-lb. for new gears and as low as 15,000 for used gears
n = 150
q = 2½ to 2¼" = .208 to .229 ft.

Using the low value of C and the high value of q the highest safe retarding force F is

$$F = \frac{4 \times 15{,}000}{150 \times .229} = 1750 \text{ lb.}$$

Assuming that the light car weighs 40,000 lb., that the full emergency air pressure would produce a brake pressure of 60 per cent of the weight of same or

$$.60 \times 40{,}000 = 24{,}000 \text{ lb.}$$

and that the coefficient of friction were as high as 25 per cent. The maximum retarding force would then be

$$24{,}000 \times .25 = 6000 \text{ lb.}$$

Since only 1750 lb. is safe to use, the full air pressure of about 60 lb. per sq. in. should be reduced to

$$60 \text{ lb.} \times \frac{1750}{6000} = 17.5 \text{ lb. per sq. in.}$$

which is about the figure arrived at in the A.R.A. official brake tests.

The above A.R.A. Freight Car Specifications prescribe an initial air pressure of 15 lb. which is gradually increased for 8½ sec. before the full air pressure is applied.

Example No. 3

Emergency braking of the above train with 150 cars fully loaded, using standard type K equipment, gear travel same as in Example No. 1.

(A.R.A. Brake Tests No. 11201, 11202 and 11204 on table No. 188)

The great buffs indicate that the gears go solid.

According to formula (1) the minimum safe draft gear capacity for such a train at the above gear travel and under all load and speed conditions would be

$$C = \frac{Fnq}{4} = \frac{6000 \times 150 \times .273}{4} = 61{,}400 \text{ ft.-lb.}$$

which proves the inadequacy of any commercial gear for this service.

If a gear of the above capacity were used the critical car mass could be computed from formula (4)

$$M_1 = \frac{L^2 C}{q^2 v_1^2} = \frac{37^2 \times 61{,}400}{.273^2 \times 600^2} = 3130$$

(Continued on page 327)

Tests of Box-Car Designs Made by A. R. A.

The Car Construction Committee investigates stresses in box-car structures of three designs by extensometers and deflectometers. Upon completion of this investigation the loaded cars were subjected to impact tests at speeds up to 18 m. p. h.

AN important and extensive research of the stresses and deflections imposed by static and dynamic loads on all important detail members of box cars of three designs has been completed by the Car Construction Committee and a report with numerous charts has been submitted to the Mechanical Division. No similar experimental research of such completeness has ever been attempted.

After completion of the stress tests the cars were subjected to severe impact tests to determine the effect of collision blows on sills and other structural members. The fundamental objective in this portion of the tests was the determination of the ability of box cars of the new A.R.A. standard design to withstand abnormally severe punishment resulting from collisions at speeds well beyond those to which the various kinds of lading ordinarily transported in such cars could be expected to escape severe damage or destruction. A further object was a comparison of the performance of this design with other earlier significant designs typical of modern box-car construction.

Car Designs Tested

The following box cars of three well-known designs were selected for test:

(*1*) *A.R.A. Standard Design.*—This is a steel-sheathed wood-lined box car of 50 tons nominal capacity submitted in 1932 and illustrated and described in A.R.A. Circular DV-768.* Five of these cars were completed in September, 1933. Their light weight was about 44,000 lb.

The program under which this car was created had as its object the production of a design representing the latest state of the art in reference to weight, cost, construction, strength, distribution and utilization of materials employed, general utility and dependability for general interchange service, so that when completed the car would be too attractive for railroads to disregard and would be of such character that any road might adopt it as standard and construct thereto its future equipment of this type.

Approximately 3,500 lb. of weight were saved in the car body as compared with existing constructions of equivalent size, capacity and type. No alloy steels or integrally welded constructions were used except for the welded center-sill seam, but the belief was expressed that in the not far distant future both these deviations from present general construction practice might be expected to provide further practical means of reducing weight. During the past year or two steel manufacturers, through requests from and co-operation with certain car builders and manufacturers, have made definite progress which apparently is about to result in quantity production at non-prohibitive prices of certain alloy steels having improved properties suitable for use in the construction of still lighter freight cars. This subject is now receiving active study with a view to early constructive action if found practicable.

(*2*) *Tentative A.R.A. Design.*—This was first submitted in 1923, being illustrated and described in A.R.A. circular DV-286.† The car used for the stress tests was Pennsylvania No. 52748, built in October, 1929, according to these drawings. The cars used for the impact tests were Pennsylvania Nos. 100297 and 100289, built in April, 1933. Their light weight was approximately 47,000 lb.

(*3*) *U.S.R.A. Design.*—This was produced in 1919 and a considerable number of cars were constructed for a number of roads. The car used for the stress test was New York Central No. S-93095, built in 1929. The cars used for the impact tests were (N. Y. C.) Nos. S-93413 and S-93087. Their light weight was 47,600 lb.

Reasons for and Objects of the Tests

Five sample A.R.A. standard cars having been completed in September, 1933, it became highly desirable to ascertain the extent to which the objectives of the design had been attained; also, to make comparisons with the two significant earlier designs previously tested as a check.

Investigation by means of extensometers and deflec-

*See the Railway Mechanical Engineer, August, 1932, page 317 for description and drawings.

†See the Railway Mechanical Engineer, July, 1925, page 426, for description and drawings.

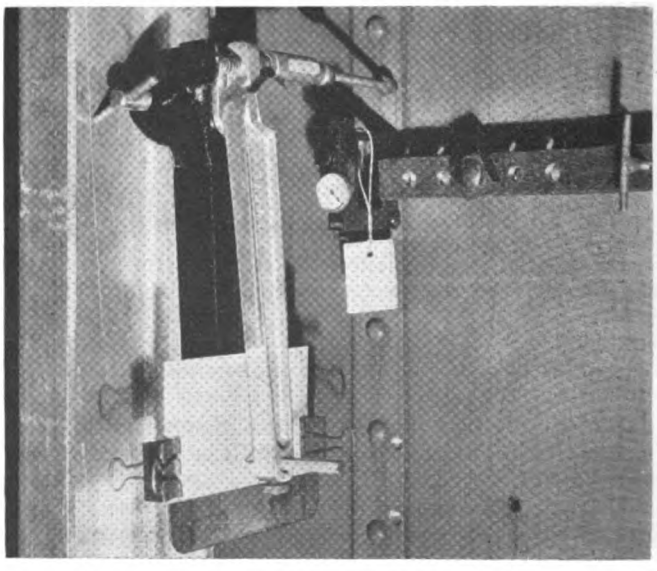


Fig. 1—Extensometer (right) and deflectometer (left) mounted on the car body

tometers of strength and deflection characteristics present in various forms of structures is not new, but this method of testing previously had not been utilized for complete car structures. About two years before the Pullman Car & Manufacturing Corporation had developed the technique and instruments required to a point where its engineering department was in position to conduct actual research by this method.

The first specific object was to check the new design and to obtain information for use later in the advancement of the art from the records thus made available of the stresses and deflections in all stress members of the car body under static and dynamic (live) load conditions. The latter were intended to approximate the effects of movements at high speeds over average trackage and road bed. A further specific object was to make direct comparison with the two earlier significant designs of steel-sheathed, wood-lined box cars.

Method of Conducting Stress Tests

The extensometer used was made by the Tinius Olsen Company and is the smaller of two instruments equipped with a dial shown in Fig. 1. In the instrument itself one leg is fixed and the other is movable, both pointers being set in accurately formed conical holes provided for the purpose. Stretch or compression in a 2-in. flat surface of the metal to which it is attached is indicated on the dial and may be identified either as tension or compression through the direction of rotation of the pointer.

The instruments are held to the car structure by means of brackets in such position that the two spacing members are free to move in either direction, and the movement of the sheet is indicated on the dial so long as the stretch is below the yield point. The amount of movement is very slight and is a function of the modulus of elasticity of the material. Each dial graduation corresponds to a nominal stress of 1,000 lb. per sq. in.

The deflectometer, the larger instrument shown at the left in Fig. 1, was developed and built by Pullman. In effect, the deflectometer is a bell crank with dampened movement, the ratio of actual deflection magnification being about 8 to 1.

Naturally, the deflectometer must be mounted on and rigidly clamped to a framework supported independently from the portions of the structure in which deflections are to be measured. This was accomplished by using the construction at the ends of the body bolsters as supporting points for the framework, which consisted of aluminum rolled channel sections and diagonal brace rods. Photographs, Figs. 2, 3 and 4, clearly illustrate the framework arrangement and application.

After mounting each instrument the pencil is brought into contact with the recording chart and a datum line is drawn before lading is applied. Deflection under static load is recorded on one side and under dynamic (live) load on both sides of the datum line. Only maximum readings are used, as the corresponding maximum deflections only are of interest.

Under static load conditions the supporting framework does not introduce any element of error, but under live load the inertia and deflection of this framework must carefully be accounted for. Consequently, tests are first made of the supporting framework only so as to determine the deflections caused by the dynamic (live) weight of the framework alone. The live-load readings for the car structure are then corrected accordingly. During the tests both deflectometers and extensometers are mounted so as to obtain readings at practically identical points throughout the structure under investigation.

All essential stress members or members which might be subjected to stresses of consequence—center sills, body bolsters, cross-bearers, end sills, roof carlines, side plates and sills, also door and side posts—were investigated for all three significant designs by taking readings at various points in these members and it was the effort under all conditions ultimately to obtain the effects of the maximum permissible loading within the car and this was worked up by progressive steps as follows.

The light-weight of the car was first obtained and the difference between this and the total permissible weight on the rail, 169,000 lb., was taken as the maximum lading to be placed in the car. The loads were uniformly distributed over the floor in the form of bags

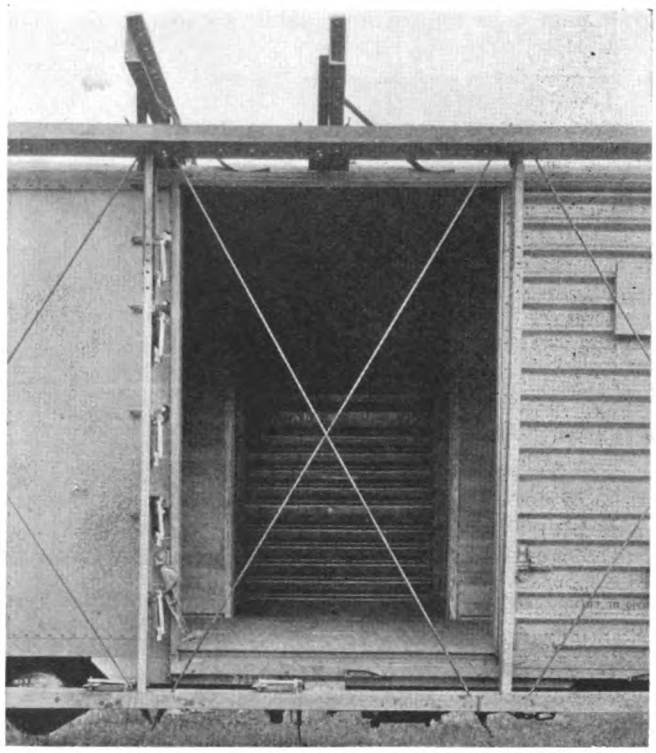


Fig. 2—Framework and instruments for testing door side posts

of sand each weighing 100 lb., together with bags of sawdust weighing somewhat less in order to increase the depth of the lading and were applied in progressive steps—one-fourth, one-half, three-quarters and full load. At full load the depth of the lading ranged from 3 ft. 7 in. to 3 ft. 8½ in. Readings were taken under each condition and from the records static line curves were plotted for deflection and stress readings.

Under dynamic or live-load conditions accurate readings cannot be obtained with the extensometer as it is an indicating device and, consequently, its inertia renders readings unsatisfactory. This does not apply to the deflectometer, as accurate readings therewith can be recorded under dynamic loads and these represent positively the deflections which are in strict proportion to the stresses occurring in the structure up to approximately the yield point of the material; therefore, the deflectometer was relied upon to obtain data showing the stresses under live-load conditions. Having obtained extensometer readings for the four increments of static loading and also having recorded the deflections of the various parts of the car body for the same conditions, a

ratio was established between deflection and stress which naturally held good for live loads as well.

Live Load Stresses

Deflection readings under dynamic loadings were taken for the same points as covered by the extensometer for each loading. The vertical impact or drop was obtained by placing wedge blocks on the rails in front of the car, located one on each rail approximately 2 in. apart longitudinally. The car was then slowly pulled over these blocks, thus producing first an impact on one side and then on the other, which not only caused a straight impact, but a rolling effect as well. The latter may be likened to the rail-joint condition.

The heights of the wedge blocks progressively used were ½ in., 1 in., 1½ in., 2 in. and 2½ in., purposely graduated so as to provide equal height increments. The

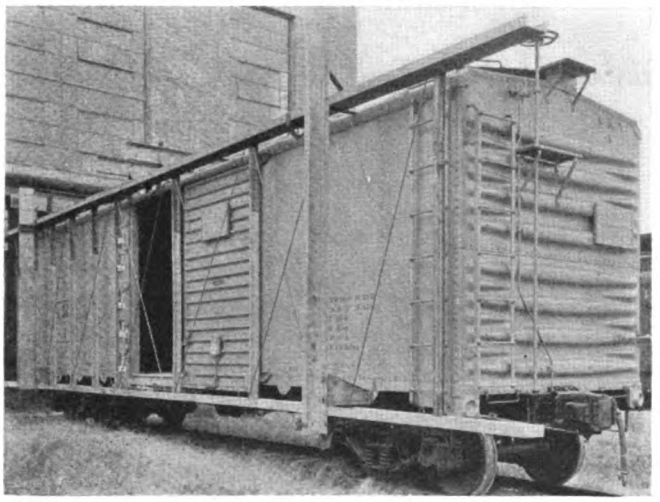


Fig. 3—General view of a car with framework for test instruments

maximum height was arrived at after many tests had been made of other cars. These had indicated that distortion of car structures under this condition was in excess of any distortion occurring in service on the road.

The records thus obtained made it possible to plot deflections for the various degrees of live loading. The static stress curves were then extended to cover the live or dynamic load conditions, using for this purpose the established stresses proportionately between the two curves. In this manner were obtained the stress readings for the maximum dynamic load conditions which, so far as is known, may be anticipated under all dynamic load forces other than those occurring as the result of buffing or end forces.

Conclusions Based on Stress Test Results

Study of the readings and comparison of the stresses and deflections in the A. R. A. standard carbody structure with those found in the two earlier designs tested indicates that the new car is stressed lower and more uniformly in its essential members than either of the other two, even though for equivalent size and capacity it is some 3,500 lb. lighter and some of its sections are smaller.

Furthermore, localization of stresses generally prevalent in other previous car structures have been eliminated and the action of the new body design under test has given definite indication that any loads applied thereto will not bear unduly at any one point within the structure, but will produce relatively smooth, well distributed stress conditions which should be reflected in terms of satisfactory service life and maintenance costs.

Impact Tests

At the conclusion of the deflectometer and extensometer tests the same three designs of box cars were subjected to a series of severe impact tests under full load. All cars were equipped with the latest design of "Dreadnaught" corrugated steel ends in order that they might have the benefit of the same degree of superstructure protection under impact. The same two draft gears, type M-17, with $2^{11}/_{16}$ in. approximate travel, were used in all impact tests. For A.R.A. standard and A.R.A. tentative designs full end loads are delivered through the draft gears to bolster center filling castings. For U.S.R.A. design the end loads are delivered through rear lugs to draft sills and through draft gears to bolster center filling castings. The couplers used on the A.R.A. standard cars were Type E with swivel shank and vertical yoke, single key; with tentative A.R.A. cars; Type E with rigid shank and vertical yoke, single key; with U.S.R.A. cars, Type D, swivel butt, with horizontal yoke, two keys. The roofs on A.R.A. standard and U.S.R.A. cars were "solid steel" with outside carlines, no vertical rivets. Those on the tentative A.R.A. cars were riveted steel with inside carlines.

Two cars of each design were used in each test, one at rest as the "struck" car and the other in motion as the "striking" car. The tests were made over a half mile stretch of level tangent track. Two feet in advance of the struck car, measured from the striking face of the coupler, a stake was driven into the ground adjacent to the running rail. Then, at distances of 52.8 ft. from the first stake, second and third stakes were similarly located. These stakes were positioned so as to be knocked down when contacting with the front journal box of the striking car. Ten feet beyond the third stake a marker was placed at the side of the track.

The striking car was then coupled ahead of a switching locomotive equipped with a speed indicator. Each run was started well beyond the marker so that an approximately constant speed could be maintained for some distance before reaching the marker. At this point the speed of the locomotive was retarded, thus permitting the striking car to separate from and move, independently of the locomotive, the remaining distance to the struck car.

At the beginning of each test two or three runs were made at progressively increased speeds with the maximum slightly below that required to close the draft gears on the two cars. This procedure was for the purpose of determining as closely as practicable the draft-gear closing speeds; i.e., the speed at which the first over-solid blows were delivered. The actual speed at instant of impact was determined by means of stop-watch readings.

Before each run coupler knuckles were opened and locks blocked in release position to prevent coupling and so that the blows would be delivered to the faces of the couplers without throwing them out of line. In addition, loosely fitted blocks were inserted on each side between the striking casting walls and the coupler shanks.

Each series of tests was run in two sections, the first being continued under progressively increased speeds until the rapidly developing wedging action of the loads in the struck ends of both cars had caused the corrugated steel ends to bulge outwardly approximately 2½ in. This procedure was followed so that each car body might have full benefit of the structural resiliency under impact which these ends are designed to provide. This

characteristic not only assists the end and its fastenings to resist the effects of shifting loads, but also provides a cushion for the surrounding car structure for protection against impact forces.

The first section included 16 to 18 runs for each car design at speeds ranging from 3 to 10 m.p.h.

At the termination of the first section of each test, the loads were leveled, the protective structures for the impact recorders repaired and restored to original condition and the steel ends were pulled back into normal position. Temporary wooden bulkheads were installed inside the cars at striking ends to provide the structural rigidity required to withstand the dynamic forces and wedging pressures of the shifting loads at the higher and progressively increased collision speeds.

When the cars were again in readiness to proceed the second portion of each test was started at initial impact speed approximately the same as the maximum reached at the conclusion of the first section of the same test. Thereafter the speeds were gradually increased until definite signs of distortion or failure had developed in the underframes or superstructures or both. The second section included five to seven runs at speeds ranging from 9 to 15 m.p.h.

Except for restoring the steel ends to normal position and straightening the door posts, account wedged outwardly by the impact recorder protective structures, no repairs of any kind were made to any car before or after any test.

Preparation of Cars for Tests

One-half of each car body toward the striking end was given a coating of cement, including sides, end, center sill and underframe members and riveted joints, so that the development of strains or distortions as the tests progressed would immediately be disclosed.

For the purpose of measuring draft-gear travel, the approximate point at which each gear first closed solid and upsetting or shortening of coupler and connections, indicating apparatus was installed. In addition, the face of each striking casting was chalked so that visible evidence of coupler horn contact therewith would be produced.

During the past few years impact registering machines have been quite extensively used by freight-claim departments of various roads and although it was realized that readings in proportion to the damaging shocks delivered to the cars not always would be registered thereby, it was decided to obtain and record such readings during the progress of the tests. Accordingly, two types of impact registers: namely, "Savage" and "Stout," were anchored to the floor of each car at the center of the door opening. The limit of Stout register is 9 m.p.h. and of Savage register 14 m.p.h. When these speeds were exceeded the registers were removed.

In efforts to protect these devices against contact with shifting lading, substantial channel-shaped corrugated-steel housings were placed over each machine and heavy continuous 8-in. by 10-in. timbers were positioned laterally on each side of the housings. The ends of these timbers overlapped the door posts, but were not attached thereto. Shorter heavy beams were fitted longitudinally within the housing so as to provide added stiffening against collapse in this direction. Bags of sand forming a part of the lading were then packed around and over this protective structure.

Impacts of 5 m.p.h. or greater, as registered by these machines, are regarded by the General Manager's Association as bad instances of rough handling with respect to lading protection, and such cases are investigated wherever possible.

Comparative Performance of the Three Designs

Although approximately the same number of runs were made with each design during the regular tests average impact speed for the A.R.A. standard cars was the lowest, being 7.33 m.p.h. as compared with 8.26 and 7.96 for the U.S.R.A. and tentative A.R.A. cars, respectively. Therefore, in the following summary of the performance and condition of the standard cars, the effects of runs 24 and 25 of the extra high-speed tests, made only with these cars, have been included. The resulting average impact speeds and kinetic energy inputs are then as follows:

Car design	No. of runs	Impact speed, m.p.h. Max.	Avg.	Total kinetic energy absorbed
A.R.A. standard	25	16.10	7.93	9,674,512
U.S.R.A.	24	15.00	8.26	10,037,762
Tentative A.R.A.	22	14.30	7.96	8,768,698

The steel ends with which all three designs were equipped functioned in accordance with design requirements and no failures occurred either in the ends themselves or the superstructure attachments.

Due to abnormal punishment considerable damage was done to the door posts of all three designs from wedging action of the impact recorder steel housing and protective timbers.

A.R.A. Standard Cars.—After the first series both cars were in their original condition and all rivets were tight.

During the second series only normal deflection of side posts and sheathing plates under the severe wedging action of the loads had taken place and no distortion had developed in the side plates or sills, end sills, underframe parts, center-sill members or roofs. All rivets in bolster center fillers, body center plates and throughout the car bodies were tight. Except for the front faces of bolster center filling castings which had become slightly indented due to contact with the rear ends of the draft gears, these cars had absorbed the punishment to which they had been subjected without change from their original condition.

U.S.R.A. Cars.—As a result of the first series the side posts and sheathing plates had become slightly bulged due to wedging of the loads. The side plates and sills, end sills, underframe parts, center-sill members and roofs remained in normal condition. All rivets in check plates and body center plates were tight, but a

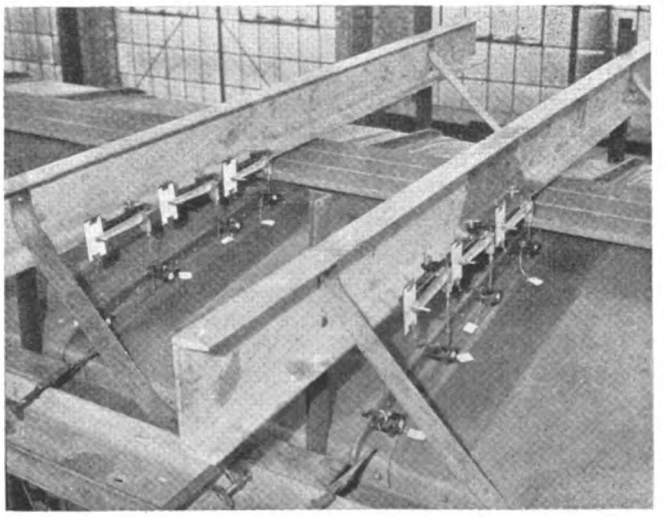


Fig. 4—Top view showing framework and instruments as mounted for testing roof carlines

number of rivets had loosened in the bolster center filler castings. One check plate casting in the striking car had cracked through a rivet boss.

During the second series bulging of side posts and sheathing plates had progressed somewhat further. Side sills and side plates had buckled approximately ⅜ in. at the door openings. End sills, underframe parts, center-sill members and roofs showed no apparent damage. Two additional bolster center filler rivets on one car and one on the other had loosened and check plates on the two cars had developed further cracks. Both car structures had begun to show definite evidence of distress at the conclusion of the tests.

Tentative A.R.A. Cars.—After the first series the side posts and sheathing plates were bulged outwardly to some extent from the action of the wedging loads. Side plates and sills, end sills, underframe parts, center-sill members and roofs were still in good condition. A number of rivets had loosened in the front lugs, bolster center filler castings and truck center plates. Loose rivets were also present in the body center plates of the striking car, but those in the struck car remained tight. Buffing faces of the bolster center filler, striking car, had become slightly indented.

After the second series the bulged condition of side posts and sheathing plates had progressed outwardly somewhat more than was found in the U.S.R.A. cars and this applied also to the corner posts. Side sills and side plates had buckled at the door opening about ⅜ in. End sills were bowed inwardly ⅜ in. at the colliding ends, indicating movement between center sills and side structure. Underframe parts and center-sill members were not damaged. Roof sheets at door opening of struck car had begun to bulge upwardly at the sides. A few additional loosened rivets were found in the bolster center filler castings, also one each in the truck center plates at the colliding ends. This applies also to two body center plate rivets in the striking car. A tendency for the bolster center filler castings to shift had developed. Under the last impact made at 14.3 m.p.h. both cars were knocked off the center plates at the non-striking ends which resulted in some damage to related parts. Both car structures were in distress at the conclusion of the tests.

Conclusions from First and Second Series of Tests

(a) Under all normal operating and service conditions, including switching operations, cars of all three designs tested are capable of giving satisfactory performance.

(b) Although a different design, cross-sectional area and weight of center-sill member is used in each of the three designs, any one of them may be relied upon to survive disintegration of the respective superstructures and related underframe constructions under collision conditions leading to destruction of the cars.

(c) Due to design and application the bolster center filler casting of the A.R.A. standard car may be expected to remain tight and in proper position and to give better service than either of the other two designs.

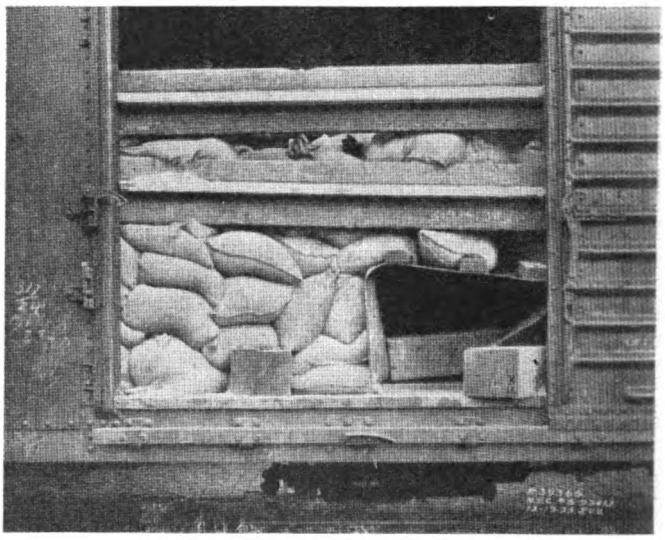
(d) Experience gained through the action of the heavy corrugated steel housing and timber blocking installed at the door openings of all three designs to protect the impact recorders indicates definitely that at switching speeds having upper limits of 5 to 6 m.p.h., lading ordinarily handled in box cars is subject to severe damage and may not be expected to survive destruction at the higher speeds under which steel-sheathed car structures of reasonably good design begin to fail.

(e) Considering the performance of each unit of equipment as a whole, the A.R.A. standard cars demonstrated their capacity to absorb abnormal collision punishment under full axle load without damage of consequence, whereas both the U.S.R.A. and tentative A.R.A. car-body structures showed unmistakable evidence of approaching failure.

(f) Punishment received by the A.R.A. standard cars during this series of impact tests was not sufficient to provide further check on the necessity for making changes in design as reported in the extensometer and deflectometer test report, but such evidence was developed from succeeding tests of these cars.

Performance of A.R.A. Standard Design under Extra High Speed Impacts

Four runs were next made at average impact speed of 16.21 m.p.h. and maximum of 18.30 m.p.h. Total kinetic energy absorbed was 5,641,500 ft. lb.



Condition of protective housing for recorder and blocking at door opening of U. S. R. A. striking car after tests at maximum speed of 10.25 m.p.h.

Definite distortion leading to failure first developed in the side plates and side sills at the door opening as a result of the side truss buckling and shear action. Moderate bulging of side posts and sheathing plates resulted from wedging action of the lading. End sills were bowed inwardly at the striking ends and outwardly at the opposite ends, indicating horizontal deflection of bolsters with resulting small relative movement between center sills and side structures. Floor support and cross-bearer diaphragms had bowed correspondingly and bottom cover plates of the latter were kinked downward between the center-sill members due to the superstructure buckling effects. No indications of distortion or failure were present in the center sills. The roofs were undamaged other than having become bent at the door openings in conformity with side-plate distortion.

Conclusions—Although the action of the car body as a unit had demonstrated the desired degree of design efficiency resulting from uniform distribution of material throughout the structure, it was plainly shown that when collision punishment is carried to the point at which actual destruction begins, the superstructure may be expected to fail before the underframe cross members become distorted to any extent and that the integral center sill would be the last important member to become defective.

Performance when Coupled at Head End of String of Cars

In the final runs one A.R.A. standard car was coupled at the head of a string of six additional empty box cars on which hand brakes were not set up. The load in this car was reduced to one half, resulting in 108,500 lb. at the rail. The striking car retained its full load.

This test consisted of ten runs at average impact speed of 10.1 m.p.h. and maximum of 14.2 m.p.h.

The cars had been turned end for end before these runs and the wedging load caused some bulging of side posts and sheathing plates. Under this reversed end loading the side sills, side plates and end sills immediately began to straighten up, but somewhat more rapidly in the struck car than in the striking car. At the conclusion of the tests both car superstructures and end sills had lost practically all distortion with no bad effects, and this applied also to the underframe cross members, except for the kinks in the cross-bearer bottom cover plates. The roofs had straightened up and were undamaged. Striking castings had not been damaged.

A number of slightly loosened rivets were found in the bolster center filler castings; also in the body center plates and diagonal braces where they had loosened up considerably. Some of these defects probably had developed during the immediately preceding high-speed runs. On the struck car the contact faces of bolster center filler at B end had not changed, but at the A or struck end indentations on the left-hand face had increased in depth from 1/8 in. to 3/16 in., while the right-hand face remained the same.

Because of extreme progressive hammering received by the bolster filler castings, which finally caused only slight loosening of a small portion of the attachment rivets during the concluding collision tests, it is considered unnecessary and inadvisable to attempt alteration of the design in efforts to guard against development of relatively slight contact face indentations. Preservation of tight rivets is of much greater importance.

Check of the center sill on struck car, which had been squeezed at the head of the string, showed only small horizontal and vertical variations from the straight-line base. Both cars benefited from the reversal of impact loading and, as a result, required less reconditioning than would have been necessary if the final test had not been made.

Conclusions—The integral Z-bar center sill of the standard car is capable of withstanding as a column under dynamic loading, without distortion or failure, a degree of collision punishment which first would cause failure in the superstructure of the car. Further, it is capable of withstanding, without damage, impact blows of sufficient intensity to cause loosening of bolster center filler attachment rivets even though the design of this casing, together with arrangement and utilization of rivets therein, is superior to either of those embodied in the U.S.R.A. or the tentative A.R.A. underframe constructions.

Changes Made in A.R.A. Standard Design

From the knowledge gained during the stress tests it was found practicable, by making a few minor changes in the design of the new standard car "as built," to improve the structure by reducing somewhat the higher stresses found through better distribution of the materials used. While these higher stresses, even under the most severe conditions, are well within the yield point and, therefore, provide adequate factor of safety, obviously it was desirable to investigate the causes of any sharp reversals or sudden changes of stresses and to improve the design accordingly.

These changes, briefly, consist of (a) change in the top rear portion of the bolster center filler casting; (b) change in reinforcement at the side sill under the door opening; (c) application of pressed pan-shaped fillers between the center-sill members in line with the cross-bearer diaphragms, and (d) increase in the width of the bolster top and bottom cover plates.

Collision performance results under high-speed impacts provided a further check on the desirability of making the changes which have been incorporated in the drawings now issued for the Supplement to the Manual.

Brake and Draft Gear Action

(*Continued from page 321*)

corresponding to a car weight of

$$3130 \times 32.2 = 100{,}786 \text{ lb.}$$

and would thus occur when the cars are loaded to about 75 per cent of their capacity.

The maximum occurring car retardation, according to equation (4) if an adequate gear were used, would not exceed

$$a = \frac{F\,(n+2)}{2M} = \frac{6000 \times 152}{2 \times 3130} = 146 \text{ ft. per sec. per sec.}$$

and the maximum occurring coupler pressure in such a train would never exceed the closing pressure of the above draft gear.

If the force closure diagram of said gear were of triangular shape, the closure being proportional to the applied force, the pressure would not exceed

$$P = \frac{2 \times 61{,}400}{.273} = 450{,}000 \text{ lb.}$$

If the gear had an initial compression of say 50,000 lb. and a straight compression line the final pressure would be reduced to the more moderate value of 400,000 lb.

The above rules refer only to draft-gear characteristics required for successful emergency braking. Satisfactory switching service requires, of course, that the gears must be able to cushion the car impacts without going solid and without developing excessive gear reactions. If the gears meet this additional requirement, they will also be adequate to take care of any shocks in train operations which may be caused by free slack.

Baldwin Power Reverse Gears

AN improved power reverse gear embodying an adaptation of the Ragonnet principle has been developed by the Baldwin Locomotive Works, Philadelphia, Pa., The valve controlling the passage of air or steam to and from the cylinder is of the rotating, flat-seat type, made of a non-corrosive alloy and provided with a double seal for the exhaust.

A new feature is a separate valve seat which is readily removable so that both valve and seat can be reground at the bench. A change of valve and seat can be made

without disturbing the piping or any part of the mechanism, except the valve cover which is held by four nuts.

The operating mechanism includes a centering device which moves the valve to its central position as the piston comes to rest and holds the valve in this neutral position until it is moved by the operator. This decreases the tendency to creep and reduces the amount of air used. The application of a guide consisting of bronze bars bolted to a lug integral with the valve chest prevents vibration of the floating lever, which, if permitted, tends to cause leakage of the valve and wearing of pins and shaft bearings.

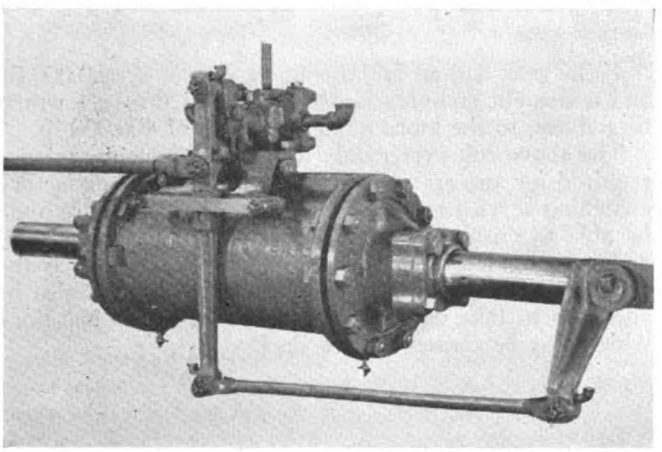
The Baldwin gear has separate air and steam supply pipes so that either source of power can be used, non-corrosive ball check valves being provided to prevent steam from entering the air pipes, or vice-versa. A test cock is included so that a steam test can be made without operating the gear.

The new gear is made in two types, one having a crosshead and guides and the other a trunk-type piston rod. The cylinder and valve assembly are identical in both gears.

The crosshead gear, Type C, has the conventional arrangement of guides cast integral with the cylinder head, and a crosshead which carries the reach-rod connection. The piston-rod packing is interchangeable with that of the 11-in. air pump and 8½-in. cross-compound compressor.

The trunk gear, Type T, has the simplicity and compactness desirable for some installations. The piston is guided by an extended piston rod of large diameter, made from double extra strong steel tubing. The piston-rod extension can be omitted if limited space demands a very short gear, but this is not recommended, since the large piston rod gives an overbalanced pressure on the piston which has a tendency to cause the gear to creep.

The gears can be assembled in a number of ways—with reverse-shaft connection either forward or backward; with the floating lever inside or outside the cylinder; with the valve mechanism above or below the cylinder. Locating the valve below the cylinder is sometimes desirable when steam is used because of the drainage feature of this assembly.



Baldwin reverse gear—Trunk type

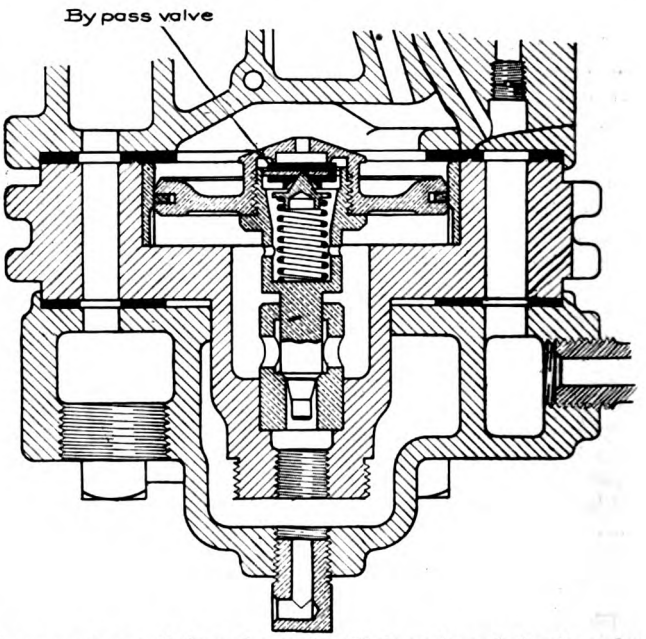
The hand lever in the cab is of an improved type. The latch has been simplified and the latch guide is made integral with the lever. The lever can be furnished with rod connection either above or below the fulcrum, also with a shaft to offset this connection to clear other parts of the locomotive. The application of a booster latch can be arranged when required.

Improved Equalizing Piston for H-6 Brake Valves

AN improved equalizing piston for the H-6 brake valve has been developed by the New York Air Brake Company, 420 Lexington avenue, New York. The piston performs all the functions of the collapsible type equalizing piston and is applicable either to new type brake valves with by-pass grooves, or old type valves without by-pass grooves.

The purpose of this piston, as well as the collapsible type piston, is to relieve any overcharge to which the equalizing reservoir may be subjected so that the equalizing reservoir and brake-pipe pressures may be at or near a balance at all times during the release manipulation of the engineer's brake valve. This is essential for example, in effecting two-application stops.

Referring to the sectional-drawing, it will be noted that a rubber-seated by-pass valve has been incorporated in the piston. This valve is seated upwardly by a spring against a seat formed in the piston head. The proportions of the parts are such that should the differential on the opposite sides of the piston exceed 2½ lb., the valve will open and allow the excess in the equalizing reservoir above the piston to flow to the under or brake-pipe side of the piston. The valve is well protected from excessive deposits of foreign substances.



Improved equalizing piston for H-6 engineer's brake valve

By using this piston it is unnecessary to send brake valves back to the manufacturer to have the grooves put in the piston bushing as is required when collapsible pistons are applied. Furthermore, there is no possibility of the piston head sticking below the by-pass grooves and making it impossible to effect a service application. The improved piston never uncovers these grooves even though this type of piston is substituted for one of the collapsible type.

A RECORD TANK. The Delaware & Hudson claims some sort of record for its recent handling of a creosoting cylinder 80 ft. 10 in. long, weighing 44 tons. The cylinder was handled on two flat cars over a 14-deg. curve at Minooka, Pa., without shifting.

EDITORIALS

The Cost of Creeping Gears

How many power reverse gears on steam locomotives now in daily operation in this country "creep" and how much does this creeping cost the railroads in wasted fuel and loss of locomotive efficiency? In answer to the first question, it may be stated that a great majority of present reverse gears creep more or less, dependent upon their type and general condition as regards maintenance. No one knows the answer to the second question, but the cost is unquestionably of considerable magnitude and probably much larger than commonly appreciated. It is represented in extreme cases, for example, by the difference in fuel and water consumption rates when operating with at least 20 per cent larger cut-offs (and restricted throttle openings) than would otherwise be required for locomotives to develop an equivalent power output.

The normal power reverse gear piston or crosshead stroke is approximately 18 in., 9 in. forward and 9 in. backward. In either corner, the cut-off approaches 90 per cent and is reduced to zero at the center. Cut-off modification, therefore, averages 10 per cent per inch of crosshead movement. Experience shows that, with a reverse lever position which is expected to give a cut-off of 80 per cent, the reverse gear crosshead will frequently creep back and forth over a range of one inch, the actual cut-off, therefore, ranging between 75 per cent and 85 per cent, a variation of 12½ per cent. The amount of creepage is practically constant for any reverse lever position which may be used since it is essentially dependent upon operating design, valve lap and lead, and the amount of lost motion in connections. With a 30-per cent mean or desired cut-off, therefore, this 10-per cent variation becomes 33⅓ per cent of the expected cut-off movement instead of only 12½ per cent, as was the case with the longer cut-off.

What difference does this excessive gear movement really make and what can be done about it? The effects at long cut-offs appear to be relatively small, but at short cut-offs, the variations in the sound of the exhaust and the effect of draft fluctuations upon the fire become seriously objectionable. The only thing the engineman can do to overcome these difficulties is to move the reverse lever nearer the corner and partially close the throttle. Assuming that the work to be done by the locomotive permits using a 30-per cent cut-off with a full throttle, but that reverse-gear creep increases this cut-off to 50 per cent (by no means an unusual increase), the throttle must be closed partially in order to avoid the development of an excessive amount of power and speed. The result is a loss in economy represented by the difference between the water and fuel consumption rates which obtain, on the one hand, with 30-per-cent cut-off and full throttle, and, on the other hand, with a 50-per-cent cut-off and partial throttle. What this means in dollars is not as definitely known as it should be. The amount, in the aggregate, however, is large enough to attract the interest of all railway officers responsible for maximum results in locomotive operation.

Restore a Sane Policy

Although there has been a decided reduction in the rate at which deferred maintenance of cars and locomotives has been accumulating during the recent spring and summer months, the railways as a whole have not yet built-up their equipment-repair programs to a point where they are keeping even with the demands for repairs which current use is creating. Four years' accumulation of deferred maintenance has yet to be dealt with. Sooner or later, with the advance of general business recovery, the growth in the volume of traffic will be such that the problem of restoring the large accumulation of worn-out equipment to service will have to be dealt with. When that time comes some conditions which did not exist, or at least were not so pronounced, during the years immediately prior to the depression will have to be taken into consideration.

During the past four years there has been a marked change in maintenance policy. Perhaps it would be better to characterize the change as an absence of policy, at least in the long-term sense. Such policy as the railways have had has been one of expediency—of reducing expenditures at any cost. This has resulted in an increase in the practice of fabricating materials and manufacturing parts which, during normal times, were supplied by purchase. In many cases, the curtailment in purchases of necessary materials left no other recourse open to the officers and supervisors of the mechanical department.

This tendency has also been accelerated by the natural desire of the railway managements to supply as much work as possible for their own employees during the emergency. It has led in some cases to undertaking the manufacture of parts for which the railway shop organization is ill-fitted by training. In some instances

the lack of appreciation of the essential value of correct materials has been very costly. In other cases the lack of adequate engineering, particularly as related to the cheapening of production costs, as well as a lack of knowledge of the whole subject of production-cost finding, make the results economically unsatisfactory.

Another condition which has been rapidly changing during the depression is the reduction in shop capacity which the concentration of repair work in central shops, accompanied by the permanent closing of outlying plants, has effected. When it becomes necessary to deal vigorously with the accumulated deferred maintenance this reduced shop capacity, although now in excess of actual use, may soon be overtaxed.

The roads will then face the necessity for a reconsideration of maintenance policies. Shall they continue their extended manufacturing operations and take up the maintenance slack by contracting for repairs with outside plants, as was done in the case of the accumulation of deferred maintenance following the end of U.S.R.A. operation and the strike of 1922, or shall they curtail manufacturing and fabricating activities, and utilize all of their facilities to the utmost for the reconditioning of existing equipment, depending upon a liberal retirement program to take care of the excess?

In following the first alternative during the years following the strike of 1922 the railways restored many obsolete units of equipment through outside contracts, the later performance of which scarcely justified the high costs of the repairs and betterments. The railways know that the lack of proper facilities for locomotive repair operations did not make for economy on many of these maintenance contracts. Do they recognize that a similar lack of facilities for production operations are inimical to economy of manufacturing operations in railway shops?

Many operations of a manufacturing character have been undertaken in railway shops on the theory that idle space and facilities were available and, therefore, only immediate out-of-pocket costs need be considered in competition with commercial prices. But when equipment-repair operations again tax the capacity of existing shop facilities the continuance of such operations can then only be justified if the full cost of space and facilities, with the proper share of other overhead items, are taken fully into account when comparing with commercial prices. Then the time comes when the apparent savings to the railroad, based on the idle-capacity theory, are used as an argument to justify additional investment to expand the plant in order that such operations may be continued or expanded.

Can the railways justify the use of their credit for the expansion of facilities far removed from the production of transportation when such facilities are already available without financial risk to themselves? The best results can scarcely be obtained by contracting with outside manufacturers for excess repairs and devoting repair-shop facilities to manufacturing operations.

Concerning Conventions Next Year

The comments which we published in the July and August numbers of the *Railway Mechanical Engineer* as to the possibility of holding conventions of the Mechanical Division and the other railway mechanical associations next year, have brought forth many reactions from both the railway men and the railway supply representatives.

The Mechanical Division, through its General Committee, has already decided to hold a full membership meeting next year. Whether it will be accompanied by exhibits depends upon the Railway Supply Manufacturers' Association and this, in turn, will depend upon the improvement of business conditions between now and the time that it will be necessary to make the decision as to whether or not the exhibits will be held. The situation is made more complicated by the fact that this decision must be made many months in advance of the convention, because of the large amount of detail work involved in organizing and arranging for the exhibits.

In general, the suggestion that some arrangement be made whereby all of the mechanical conventions meet at about the same time, in order that the railway supply people will be warranted in putting on one large exhibit, seems to meet with considerable favor. Most of the railway supply people express enthusiasm over the possibility of making an exhibit, provided an adequate attendance can be assured, and also, of course, that business conditions will be such as to warrant the necessary expenditure. Many of the railway supply representatives feel strongly that the expense of setting up an exhibit is so great that some plan should be worked out whereby only one exhibit will be necessary for all the associations. This might be made possible and at the same time not take too many key men from the railroads at one time, by having the Mechanical Division meeting immediately preceded and followed by some of the other association meetings—a week-end intervening either before or after the Mechanical Division meeting.

The consensus seems to be that Atlantic City is the only place that can house the large exhibit. There is the feeling in some quarters, however, that the attendance at the minor mechanical association meetings may be adversely affected if they are scheduled for Atlantic City, because of the long distances that will have to be covered by members from the western railroads. Most of these associations have normally held their meetings in Chicago, because of its more central location and greater accessibility for the men in the Middle West and West.

The officers of the mechanical associations other than the Mechanical Division, are scheduled to meet at the Hotel Sherman, Chicago, on September 17 and 18, to consider the question of holding conventions next year. There is a certain sentiment that it might be advisable

to have these associations hold their annual meetings in Chicago, and have a special exhibit for them. This would necessitate many of the railway supply companies arranging for two exhibits, one at Atlantic City for the Mechanical Division, and one at Chicago for the other mechanical associations.

There is a question as to whether, if only the Mechanical Division meets at Atlantic City, it will be advisable for it to spread its meetings over a sufficient length of time to justify the big exhibit at that place. Obviously the exhibitors will hardly be warranted in putting on a big show if the Mechanical Division will only meet for two or three days. There is, of course, always the possibility of the Purchases and Stores Division scheduling its meeting at about the same time as the Mechanical Division, and at the same place, thus enabling the Purchases and Stores officers to enjoy the advantage of the exhibit.

If all of the mechanical associations meet at Atlantic City at about the same time, possibly spacing their meetings over a period of eight or ten days, there is little question but what, under reasonably good business conditions, the railway supply people will be warranted in putting on an exhibit; indeed, many of them have expressed themselves enthusiastically in this respect.

There appears to be a strong possibility that some of the associations may have to change their procedures or practices more or less radically, or even to modify their forms of organization. The past four years have witnessed many changes in personnel in some of the departments. In addition to death and retirements, many officers and foremen have left the service or have been demoted, their positions being abolished. Consolidations of railroads, closer integration of subsidiaries, concentration of repair facilities, and changes in methods and practices have all combined to complicate matters.

On one system, for instance, which since 1930 has absorbed two smaller railroads, one man only is available today for membership in one of the important mechanical associations as compared to seven men in 1930. Meanwhile large improvements have been made and others are impending which make the work of this particular association of unusual importance to the railways at this particular time. While the instance cited is admittedly extreme it discloses a tendency which promises to affect all of the associations.

The issue must be met fairly and squarely and we must carry on. It will be interesting, for instance, to explore the possibilities of joint sessions on overlapping subjects, or those which may be common to two or more groups. Such things as this may make advisable closer co-operation between the different associations and may go a long way toward justifying joint meetings and a common exhibit.

The situation is so complicated and has so many angles that there will naturally be objections from some group or groups to any arrangement which may be suggested. The task, therefore, is one requiring careful study and a certain amount of compromise on the part of some of the groups, in order that the most satisfactory arrangement may be decided upon in the interests of the railway mechanical department and the railway supply fraternity as a whole.

Getting Results In the Coach Yard

In response to an inquiry regarding the principal things essential to getting desired results in coach-yard operation, a supervisor recently placed first emphasis on the need for adequate facilities for steaming and watering cars. This means ample capacity in the power plant and pumping equipment, pipe lines in good condition, with couplings conveniently located and easily engaged. Water hydrants should be so designed as to provide for rapid hose coupling, with drainage provided below the frost line for use in winter. The mains should be large enough so as not to restrict either the supply of water or the water pressure.

Another important feature is the co-operation of the operating department with respect to the location of special and extra trains when regular yard space is not sufficient to accommodate the additional business. Walkways throughout the coach yard should be maintained in good condition at all times to speed up and simplify the handling of supplies, materials, etc. Considerable time can be save by using tractors in supplying coal and ice, providing these walkways are not only kept in good condition but the space between tracks is maintained wide enough to permit passage of the tractors.

The proper arrangement of repair pits to accommodate a group of cars so that repairs can be performed in a progressive line without undue delay occasioned by switching is essential. Obviously, the operations are greatly retarded when repair pits are so located that cars cannot be released until some single car is switched out of the way by a locomotive. The lack of wheel- and axle-turning machinery often causes delay to equipment and all large coach yards should be made self-supporting in this respect. Numerous problems arise in connection with the cleaning of cars, and it is essential that foremen constantly check their work and forces to maintain clean cars at a minimum cost per unit cleaned.

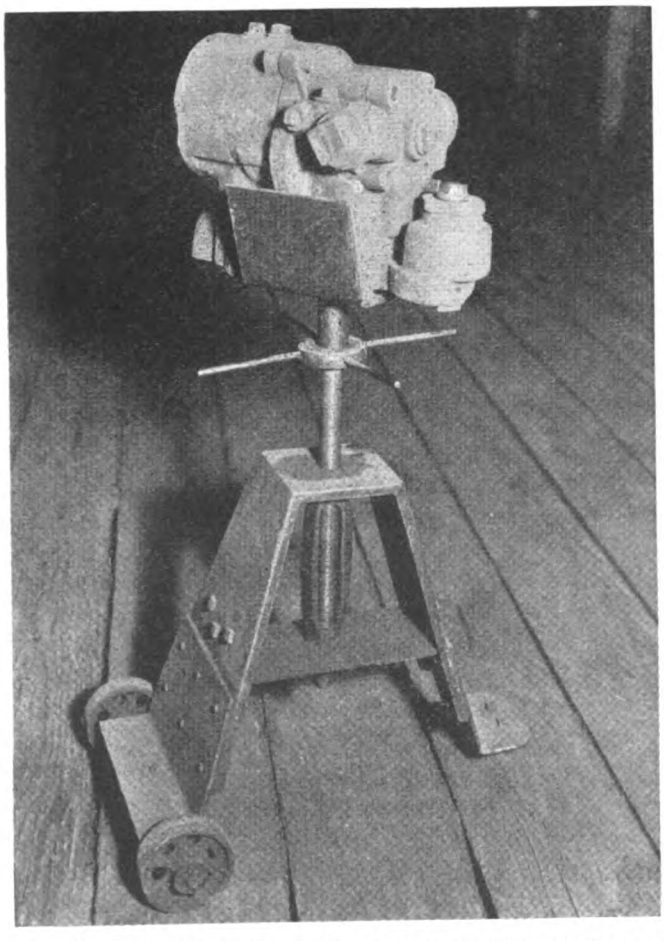
In connection with general coach-yard operation, the emphasis on elimination of personal injuries should never be allowed to lapse, since almost no department possesses greater possibilities of accident. Supervisors should be ever on the alert to educate the workmen and to help the ambitious employees who are anxious to advance as a result of their own efforts. Such men should be encouraged and assisted in their efforts to study and qualify themselves for positions of greater responsibility.

With the Car Foremen and Inspectors

Jack for Handling U. C. Valves

A CONVENIENT, portable jack for use in removing and applying U. C. universal valves, reservoirs, brake cylinders, etc., to passenger cars is shown in the illustration. It consists of a steel A-frame suitably reinforced and equipped with two small truck wheels on the wide leg of the A-frame and with a swivel caster on the other narrow side of the frame. A square-thread screw, provided with a collar and four small projecting handles for turning it, is applied through suitable holes in the top of the A-frame and the cross brace, being threaded into an elongated nut which is welded to the A-frame to prevent turning. The upper end of the screw is equipped with a revolving special saddle which turns readily on the screw and which also is removable so that a saddle of different shape can be substituted, if required.

This portable jack for use in applying air-brake parts underneath a passenger car is light and easily handled, and it not only greatly facilitates the work but also contributes to safety, since the more or less heavy air-brake parts can be applied without the use of make-shift blocking which is likely to slip and cause accidents.



Portable jack for use in applying and removing passenger-car air-brake material

Machine Practice in the Car Wheel Shop*

THE importance of proper methods of mounting wheels can hardly be over-estimated, not only in relation to shop costs but as an outstanding factor in wheel performance. It is, therefore, only logical that if the best machine-shop practices of the many wheel mounting shops are brought together and formulated into standard rules of practice, it will result in far greater uniformity of methods and more satisfactory results in mounting wheels.

To do good machine work of any kind, the equipment must be rugged enough to stand the punishment it will be subjected to. Of equal importance is the necessity of keeping the machines in good condition. Worn machinery makes it almost impossible to produce work without taper or chatter marks and, where this occurs in the surface of the axle-wheel seat or the bore of the wheel, the desired consistent mounting pressures in pressing the wheel on the axle cannot be obtained.

Axle Lathe Practice

The lathe is too light. The ways are worn. The centers are worn and gouged. These three conditions, or some combination of them, make up the common diagnosis of poor axle work. The correction of the first two are obvious. The worn and gouged centers can be renewed.

Because of the severe punishment that an axle lathe center must stand and because of its extreme importance in producing accurate machine work, it is suggested that the old fixed or dead center be replaced by a roller-bearing center. While the initial cost may be relatively high, the superior performance plus the lower maintenance cost justifies its use. Due to the fact that the roller-bearing center rotates with the axle, it is possible to grind it to 77 deg., and thus handle axles with either 60-deg. or 77-deg. centers.

Axle Lathe Tools

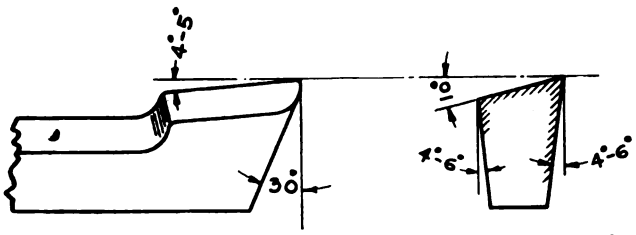
Even with equipment in excellent condition, unquestionably, the most important factor in machine work is the design of the tools. All cutting tools can essentially be considered as wedges forced into the material to separate it. A tool with a thin edge cuts more easily because less friction is generated; it distorts the chips less and removes them with greater freedom. In order to withstand a heavy cut at a suitable speed, the tool must be thick enough and also have sufficient width to withstand the heat generated by friction. Excessive heat due to the improper shape of the tool will soon cause its destruction. Also, the material being cut will in part govern the cutting speed. A portion of the heat is conducted away through the work and thence to the air, while the remainder travels from the edge into the body of the tool, from which it radiates to the air. Some heat is

*Condensed from a pamphlet "Theory and Practice of Mounting Railroad Wheels on Axles", published by, and available upon request of, the Association of Manufacturers of Chilled Car Wheels, McCormick building, Chicago.

carried away by the chips, themselves, and by the lubricant if it is used.

The cutting angle or keenness of the tool is either increased or decreased by changing the rake angle of the tool. Generally speaking, cast iron is successfully cut with the cutting angle of between 70 deg. and 80 deg. and steel with an angle from 40 deg. to 60 deg. Not only must the tool be ground to the proper angle, but also of vital importance is its height relative to the axis of the work in the lathe.

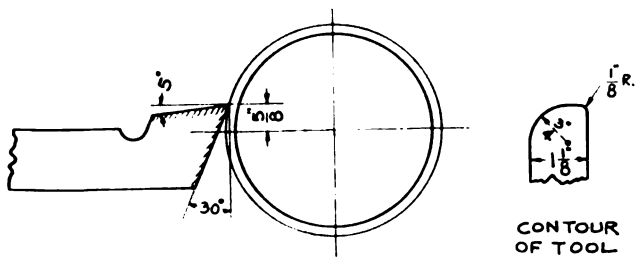
When the tool is set below the center, the effect is to rapidly decrease the front rake and increase the clear-



Correctly designed right-hand axle-roughing tool

ance, and, as a result, cause the tool to tear the metal instead of cutting it. The effect of wear in the lathe on the quality of work it is capable of doing, is also aggravated by setting the tool below center. A tool set too high above center may go so far as to eliminate all of the front clearance and thereby compel the tool to ride on the work and destroy the edge by friction. In other words, the front clearance on the tool governs the maximum amount that the tool can be set above center and still be able to cut.

Theoretically, the angle between the horizontal and the line drawn from the center of the work through the cutting edge of the tool should be equal to the end clearance angle of the tool. When set at this theoretical height, however, the tool has no effective end clearance so that, in practice, it is set slightly below this point. In no case should it be set higher. Hence, eliminating other



Preferred design and setting for axle finishing tool

considerations, the diameter of the stock being turned and the clearance on the tool govern the height that the tool can be set above the center. When turning large diameters, the tool can obviously be set much higher and still retain ample clearance.

The shape of the tool, in the final analysis, is governed by the material to be machined, and must satisfy the physical properties of the metal it is cutting. When machining cast iron, the chips break off short, due to the graphite, and, in reality, the tool is cutting and then breaking off the metal. Steel, however, because of its ductility and tenacity, must be cut or shaved off and hence the chip should come off in continuous smooth curls.

The condition of the lathe also influences the correct heights at which the tool should be placed. The only reason for placing a tool above the center line of the work is to eliminate chattering of the tool. Hence, when working with a lathe that is worn, the tool, out of necessity, must be set unusually high to eliminate this defect, at least partially.

It must be borne in mind that first of all, for a given material which is to be machined, the first elements of consideration are the "angle of approach" and the "angle of keenness." Having once established these angles, then the remaining angles, namely, the front clearance on the tool, and the height above center at which the tool is to be used, are elements of design which are dependent upon the condition of the lathe and the diameter of the work that is to be turned.

Axle lathes are expected to work within comparatively close limits and yet are subjected to extreme punishment. As a consequence, after a comparatively short period of service, they develop sufficient vibration and it is necessary to design tools so that they will at least partially compensate for the condition of the lathe. The present A. R. A. Wheel and Axle Manual shows the tool set 3/16 in. above center. However, the practice at wheel shops, with very few exceptions, is to set the tool from 1/2 in. to as much as 1 in. above center, invariably being higher on lathes which have become worn.

Another important factor in tool performance is the life of the tool. It is quite evident that the keener the tool, the less punishment it will withstand and the sooner it will require grinding. Therefore, the cutting angle should not be any more acute than is necessary to cut the material. Excessive rake and an unnecessary amount of clearance lead only to short tool life. Tool clearance above what is actually required for proper performance is probably responsible for the greater portion of tool failures.

Heat Treatment and Grinding

The heat treatment and grinding of tools is also of paramount importance. Each type of tool steel can deliver satisfaction only when carefully and properly heat-treated. The best steel which can be produced, regardless of cost, will not do the work expected if it is improperly hardened. The manufacturer of the steel is in the best position to recommend the proper treatment, and his advice should not only be sought but followed.

Hardened tools can easily be ruined by careless grinding technic. Local high temperatures, caused by too great a pressure against the abrasive wheel, result in grinding cracks. This is particularly true of high-speed steel. Also, an abrasive wheel which is too fine or too hard does not cut but, instead, burns the steel. During grinding, tools that have become hot should not be quenched in cold water to cool them for it almost invariably causes minute cracks. When possible, grinding should be done on an abrasive wheel on which a generous supply of water is flowing and thereby prevent overheating of the tool. If conditions permit, the most consistent quality of work can be obtained when all tools are ground in the tool room by a trained man who is charged with this responsibility.

The grinding operation invariably leaves a coarse surface on the face and a pronounced feather edge on the cutting edge of the tool. When the tool is placed in service and expected to do quality work, it fails, first, because the feather edge breaks off the instant the tool makes contact with the work, leaving a blunt instead of a keen cutting edge; and, second, because the rough ground face of the tool resists the shavings as they are compelled to pass over it and very soon causes them to pile up and stick on the tool. Either of these two conditions results in a rough finish instead of a smooth surface suitable for rolling. To overcome this, the tool should be honed, to eliminate coarse grinding marks and

remove the feather edge. It can safely be stated that honing adds considerably to the useful life of the tool before regrinding is necessary and greatly improves the quality of a finish cut.

These rudimentary facts are all common knowledge to the modern tool maker, but their observance is of such extreme importance that they must be constantly emphasized.

If all lathes were of the same design, running at the same speed and in uniformly good condition, very definite angles could unquestionably be established on the cutting tools. Unfortunately, these ideal conditions do not exist and, hence, recommendations which involve certain limitations must be made. One of the illustrations shows the shape of a roughing tool to be used for turning axles. This tool not only has a substantial front rake but a decided side rake and should be set about one-half inch above the center line.

Particularly when heavy cuts are taken, a roughing tool of this design will clear itself of chips and require less power. The illustration shows a right-hand roughing tool; a left-hand tool would necessarily have to have a side rake in the opposite direction.

Finishing Tools

The general contour of a finishing tool, as shown in the present Wheel and Axle Manual, has been adhered to, but, in addition, there are very definite recommendations with regard to the amount of rake and front clearance on the tool, together with the height at which the tool should be set. The importance of setting the tool at the recommended height cannot be over-emphasized, and it is, therefore, suggested that axle lathes be equipped with tool posts which will hold the tool at a definite height.

The conventional tool post utilizing either a rocker or step washer for changing the height of the tool is not recommended, since this arrangement out of necessity disturbs the angularity of the tool when its height is changed. If, on the other hand, the shank of the tool is always held in a horizontal position and the height of the tool altered by placing full length straight shims of varying uniform thickness under the tool, regardless of what height the tool is set, the fundamental angles between the work and the tool are not disturbed. Another illustration shows that the tool should be set at $\frac{5}{8}$ in. above the center. This is considered the minimum height, the height actually having to be changed, dependent upon the diameter of the journal or wheel seat that is being turned. In reality, the tool height should be increased until the tool is just on the verge of losing its front clearance, and, as a result, riding, rather than cutting the axle. Then, having established the proper height, it must be maintained at all times, unless perfection of finish is to be sacrificed.

Axle-Lathe Speed and Feed

For roughing cuts, the speed and feed are governed only by the punishment that the cutting tool will withstand. For finishing, however, where the final finish of the axle surface is an important factor, the longitudinal feed is regulated primarily by the shape and width of the finishing tool. In the final analysis, the feed must be sufficiently fine so that the finished surface has the desired smoothness. The finished surface must be as devoid of tool marks as possible, this being particularly true of the journal. When the finishing tool leaves either coarse tool marks or a ragged surface, it is almost impossible subsequently to remove the evidence by the rolling operation.

There are axle lathes running as slow as 34 r. p. m. and as fast as 200 r. p. m. and, consequently, the feeds used are not the same. On the fastest running lathe, a $\frac{1}{32}$-in. feed per revolution is used for both rough and finish cuts. On lathes running a little over half this speed, the rough feed is $\frac{1}{16}$ in. per revolution and finish feed $\frac{1}{32}$ in. per revolution. With the lathe speed down to 35 to 60 r. p. m., the rough feed is $\frac{1}{8}$ in. per revolution and the finish feed either $\frac{1}{16}$ or as little as $\frac{1}{32}$ in. per revolution.

The best finishes are obtained where the tendency is to run at higher rotational speeds and finer longitudinal feeds. In any event, it is impossible to obtain the essential quality of finish unless the final feed is $\frac{1}{16}$ in. per revolution or less. In answer to a question on this subject, 48 out of 69 railroads shops report the use of a $\frac{1}{16}$-in. feed.

Boring-Mill Practice

The boring of wheels is equally important as the machining of axles (in fact, they are inter-dependent). Boring mills used for this work are subjected to severe punishment and still must work within very close tolerances. A mill that has been neglected soon bores wheels that are either out of round or tapered several thousandths of an inch. Although this is primarily caused by excessive play in the boring bar, it is also materially aggravated when excessive cuts are taken or the mill is operated at speeds in excess of what it was designed for. In the final analysis, the depth of cut, feeds, and speed of rotation are determined by the condition of the mill. As a general rule, a feed of $\frac{1}{8}$ in. for roughing and $\frac{5}{16}$ in. for finishing produces the best results.

In addition to checking the condition of the boring bar by carefully calipering wheels bored on the mill, the jaws of the mill should be checked at regular intervals to assure that it is boring concentric with the tread of the wheel and at right angles to the plane of the flange. Probably the simplest method of checking the concentricity of the jaws of the mill is to have a standard ring turned with a contour identical with that on the wheel tread and flange. This ring can then be placed in the jaws of the mill and indicated by clamping a gage onto the boring bar of the mill. An alternative of this method is suggested in the Wheel and Axle Manual in which it is recommended that a portable grinder be clamped to the boring bar and the mill placed in operation.

Grinding Boring-Mill Cutters

It is highly essential that the boring-mill cutters not only be ground to a definite contour but they must also be of equal length so that, when placed in the boring bar, each cutter will take the same depth of cut. If the cutters are not of equal length, it is impossible to caliper the cutters and expect them to bore the wheel the same diameter. Furthermore, if the cutters are of unequal length, there is a tendency for the boring bar to be crowded to one side and the resulting bore will not be concentric with the wheel.

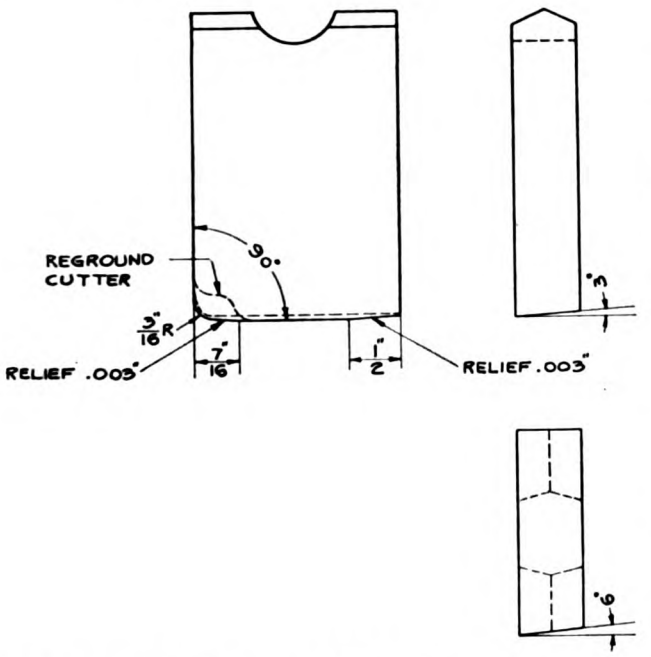
The most satisfactory method of grinding boring-mill cutters is to build a jig which will hold both cutters at the same time, grind them to the same length and establish the proper angles as well. A grinding jig of this kind will soon pay for itself in the form of lower tool costs and consistently good boring practice.

Boring-Mill Cutter

The necessity for having a perfectly cylindrical bore, uniform in diameter and with a smooth finish, can hardly be over-estimated. To accomplish this, the boring-mill cutters must be properly designed and their contour must be maintained. One of the illustrations clearly shows the

essential elements of a boring-mill cutter for boring chilled tread wheels.

It is well to note that, in addition to the 3-deg. clearance on the end of the tool, the leading cutting edge and the trailing edge have been very slightly relieved. Even though the cutters are supposedly rigidly held in the boring bar, under the stresses that they are subjected to when making a cut, there is a tendency for them to yield, particularly when entering and leaving the bore of the wheel. This quite naturally has the effect of taper-boring



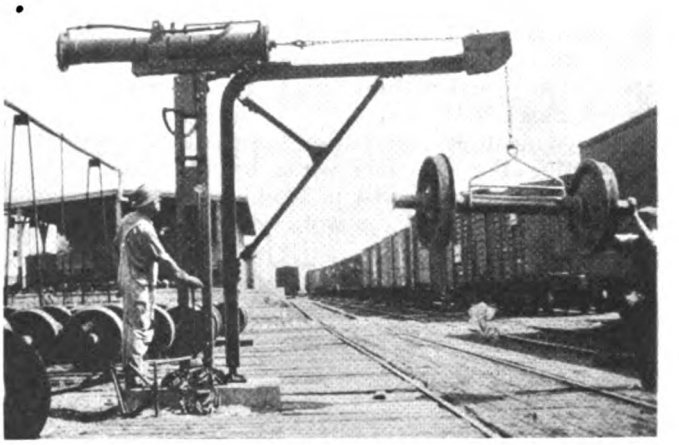
Roughing and finishing cutter for boring cast-iron wheels

the wheel, and experience has shown that, by slightly relieving the tool, this condition is eliminated. The relief on the cutters also assists them in finding themselves in the rough bore and thereby giving added assurance of producing a true finish bore suitable for mounting. As is evident from the drawing, new cutters are used for making finishing cuts, and, after a number of regrindings, are used as roughing cutters.

Air Hoist for Handling Car Wheels

By P. P. Barthelemy

FOR unloading and loading mounted car wheels, a great many devices are used, ranging from a gantry crane, electric, air and hydraulic lifts and depressed tracks to the old-fashioned loading skid. An inexpensive but efficient type of air hoist particularly suitable for handling wheels is shown in the illustration. As will be noted, this consists of a horizontal air cylinder mounted on a swinging boom which is secured to a rigid mast set in concrete. The boom has a wide swing and is so set in relation to the loading and unloading track that the tongs hang over the center line of the car and swing over the loading storage track. The wheels may be handled from and to a parallel or transverse supply track with ease and safety. The handling tongs, it will be noted, engage the axle between the wheels and its members are wide-spread to prevent side slippage. Chains, cables, or any other kind of sling over the jour-

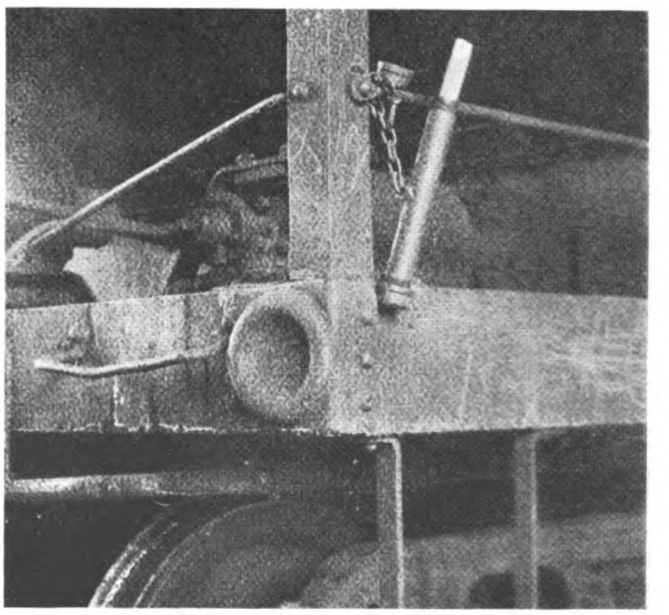


An inexpensive but efficient swing boom and pneumatic hoist for use in loading car wheels

nals are prohibited. This hoist is of such height that it will swing into the doorway of a box car and is useful for loading and unloading bolsters and other heavy materials. When not in use the boom is locked in a clear position.

Container for Work Reports

THE container shown in the illustration is used by the work inspector in the car shop for filing work report cards and at the same time keeping the report



An easily made work report container

with the car so as to give information to the foreman and workmen as to what work is still required. Placing

the work report in the truck springs of the car as formerly done did not prove satisfactory for the reason that it frequently became lost or was soiled by either grease or paint.

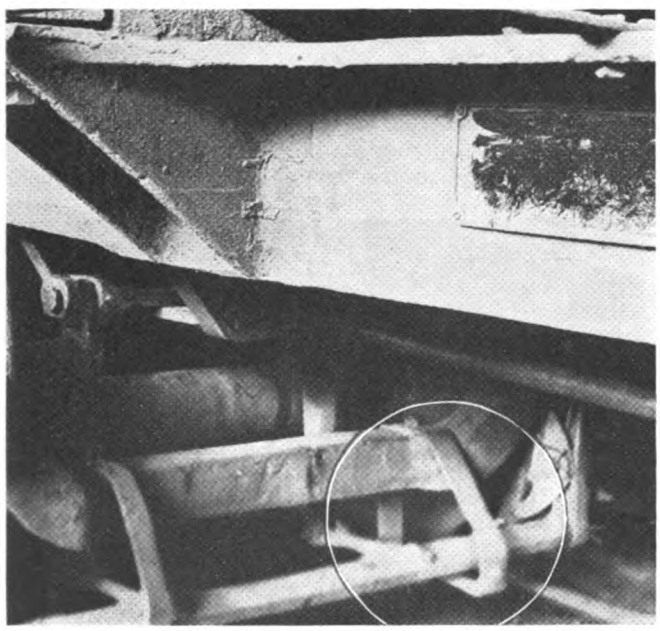
The container consists of a piece of one-inch pipe about 12 in. long to which a pipe cap is applied on each end. The cap can be removed easily for insertion or removal of the work report. A piece of light-weight chain with a spring catch is spot welded to the center of the container and permits attaching the container to the corner posts, grab irons or to any part of the car that is not going to be removed during the repair period.

Painting the container some bright color, such as red or yellow, will assist in readily locating it when it is desired to examine the work report or to make additions to it.

Brake Beam Safety Support

LOCOMOTIVE tenders equipped with six-wheel type cast steel trucks having the "clasp" brake requires the use of six brake beams for each truck. It is impossible to adapt the ordinary freight car brake beam support to these trucks due to the absence of a spring plank, however it is desirable to provide safety protection to the brake beams especially where this type of equipment is assigned to high speed freight and passenger train service.

One method of applying a safety support for the brake beams on this type of truck is shown in the accompanying illustration. The support is made in two pieces to facilitate its removal when replacement of brake beams becomes necessary. Two pieces of ½ in. by 2½ in. wrought iron is formed in the manner shown and bolted to the truck side cross brace. Should a hanger pin be lost out or a brake hanger break while the engine is in service, the brake beam will be supported by the safety support and probably prevent a train delay if not a serious accident.



Six-wheel truck safety support for brake beam

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Damage by Cutting Hole Through Door from Inside

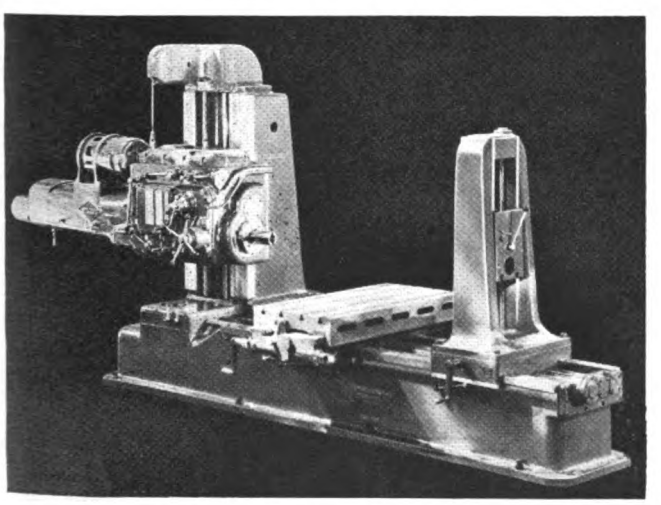
Pacific Fruit Express refrigerator car 4884 was delivered to owner's shop by Oregon Short Line with the following uncarded damage: Two side-door sheathings broken and part missing; hair insulation and insulation paper torn and missing; three side-door lining boards broken and cut with knife. Owner requested defect card, but railroad refused, claiming that damage was car owner's responsibility. Being unable to reach an agreement the matter was referred to the Arbitration Committee for decision. P. F. E. contends, based on paragraph 5, Rule 32, that delivering line is responsible for cutting out or removing parts of cars to facilitate loading or unloading or for other purposes; that parts in question were cut out for "other purposes." Delivering line contends that owner is responsible for damage originating from inside of car and declined to furnish defect card, although it acknowledged that if it is found that the damage involved malicious cutting of a hole in the door there is no question that the company permitting such damage is responsible. Damage was found by outside inspection with side doors closed, and thus it is not a question of concealed damage, such as fire damage or other damage, of which delivering line may be unaware at time of delivery. P. F. E. admits that an interior inspection over interchange is not required, but contends that defects such as under dispute can be and were found by outside inspection and, therefore, is a responsibility of delivering line. Included in evidence submitted by Oregon Short Line was a statement of car foreman giving reason for not issuing defect card, stating that damage was evidently done by some party inside of car cutting way out on inside door and breaking out outside door sheathing boards. Cutting was not visible from outside of car with door closed. When P. F. E. first presented claim they suggested that damage might have been caused by trucks backing against the door when open during loading or unloading as had occurred in a number of cases, but this was clearly not the case. It is acknowledged that the hole in the door could be seen and was found by exterior inspection, but it is contended that the only damage visible from the outside with doors closed was two broken-out side boards and that visible evidence of lining boards being cut could not be determined without interior inspection. Complete statements and correspondence was attached. In substance the O. S. L. contends that principle of section k, Rule 32, and interpretation 5 properly apply and that it is not liable for the cost of repairs.

In decision rendered October 26, 1933, the Arbitration Committee said: "In view of statement by the Oregon Short Line that it has no record of the damage occurring while car was in its possession, it is responsible only for such damage as could be observed from exterior inspection with door closed. Defect card should be issued accordingly."—*Case No. 1732, Pacific Fruit Express Company vs. Oregon Short Line Railroad.*

In the Back Shop and Enginehouse

Horizontal Boring, Drilling And Milling Machine

A NEW horizontal boring, drilling and milling machine, designated as No. 400, has been designed by William Sellers & Company, Inc., Philadelphia, Pa. This is a flexible, rapid and accurate tool, well suited for general purpose work. A prominent feature of this machine is the unit head construction which provides a remarkably short and direct drive to the spindle. All drive, feed and traverse mechanism is contained in one unit with the spindle. This results in rigidity, efficiency and a smooth, steady drive to the spindle. A 10-hp. constant-speed motor, 750 r.p.m., either a.c. or d.c., is mounted on the unit head. Controls for speed and feeds are conveniently grouped on the head where they can be easily reached by the operator. Power traverse or hand movement of head, table and saddle is also controlled from the head, a micrometer dial being provided to indicate movement. A friction clutch reversing mechanism provides for instantaneous start, stop and reversal of the spindle, an advantageous feature in tapping. The spindle is of 4 in. diameter and fitted with a No. 6



Sellers No. 400 horizontal boring, drilling and milling machine

Morse taper hole. There are 24 speed changes, 9 to 500 r.p.m., while feed per revolution of the spindle ranges from .0025 in. to .625 in. The vertical adjustment of the head on the column is 72 in. and the maximum distance from the face of the spindle sleeve to the outboard bearing is 31½ in. The outboard bearing may be easily removed if desired to accommodate long work. The standard table size is 30 in. by 60 in., with a cross travel of 46 in. and a longitudinal travel of 38 in.

Variations in length of bed, column height and size of table may be made to suit special requirements. Among attachments obtainable are boring bars up to 4 in. diameter; circular or square swiveling tables; auxiliary tables; milling cutters; star-feed facing heads for diameters up to 24 in.

Machining Rod Bushings and Valve Packing Rings

SOME indication of the ability of modern machine tools to produce locomotive parts in considerably less time than many of the obsolete machines still in use in railroad machine shops may be taken from the operation studies on two jobs, the details for which are given in this article. The operations outlined and the time given in the case of the rod bushings are taken from production records on a 36-in. Bullard vertical turret lathe and those relating to valve-packing rings, from a Bullard 24-in. vertical turret lathe.

Finishing Rod Bushings

Fig. 1 shows the diagrammatic set-up of turret tools for the first chucking, consisting of three separate operations for the finishing of 8½-in. outside diameter side-

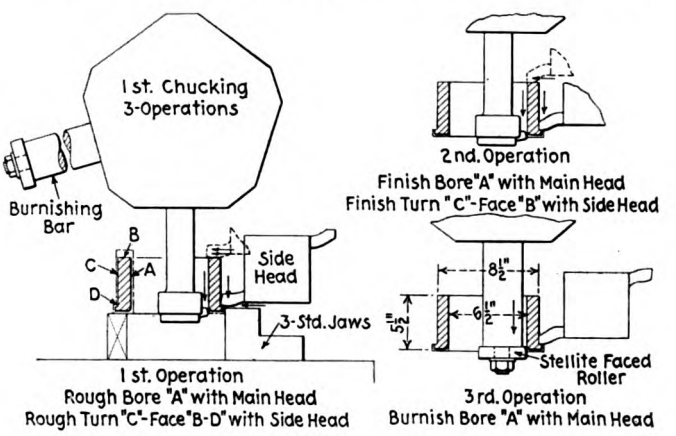


Fig. 1

rod bushings. The first operation consists of rough boring the outside of the bronze bushing casting with a tool in the bar of the main head at the same time that the outside of the bushing is turned with a tool in the side head. At this same setting the surface *B* and the shoulder *D* are faced with a side-head tool. For the first operation a table speed of 60.2 r.p.m. is used which, together with a feed of .068 in., results in a cutting speed of 102 ft. per min. for the boring of surface *A* and 137 ft. per min. for the turning and facing of surfaces *B*, *C*, and *D*. After the completion of the rough boring and turning operation the cutters in the bar are changed and the side head indexed for the finish boring and turning of surfaces *A* and *C* and the facing of surface *B*, which comprises the second operation performed at a table speed of 86.5 r.p.m. and a cutter feed of .068. The third and final operation at the first chucking is the burnishing of the bore of the bushing with a Stellite faced roller in the bar in the main head. The same table speed and the same feed are used for the burnishing operation as are used in the second or finishing operation. The three operations of the first chucking may be performed on a bushing of this size in 6 min. elapsed time.

The second chucking on the same bushing consists

also of three operations, the first of which involves the rough facing of the top flange with the main head while rough turning the outside diameter of the same flange with the side head. For this roughing operation a table speed of 62 r.p.m. is used and a feed of .068 in. The

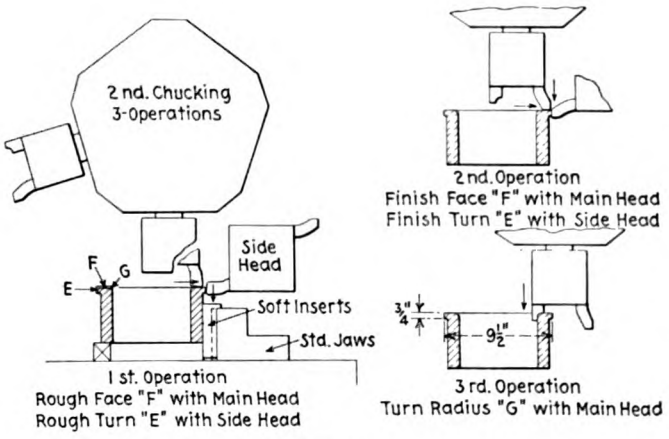


Fig. 2

second operation consists of the finish facing of the top of the flange with the main head while finish turning the outside diameter with the side head. These operations are shown as surfaces *E*, *F* and *G* in Fig. 2. For the second operation a table speed of 69.7 r.p.m. and a feed of .068 in. are used. The third and final operation of the second chucking is the finishing of the radius in the bore of the bushing with the main head which is performed at

from the table. The time given here is that for the finishing of a single bushing, and an average production of five pieces per hour should be maintained without difficulty, allowing for an average efficiency of operators of not over 85 per cent.

Machining Valve-Packing Rings

One of the most interesting machine-shop jobs on locomotive parts is machining packing rings. The operations described here are shown in Fig. 3 and the time given is in consideration of the use of multiple tools together with a ring-holding device to collect the rings after they are cut off. The entire finishing of these valve-packing rings from a packing tub 12⅞ in. outside diameter is performed at one chucking wherein the tub casting is held in a three-jaw chuck and the work is performed in four separate operations. The first operation consists of rough boring the full length of the utb with the main head of the machine, while at the same time the outside is rough-turned with a tool in the side head. On these operations a table speed of 22 r.p.m. is used with a feed of .056. The second operation consists of the finish boring of the full length of the tub with the main head and the rough recessing of 19 grooves for as many rings with a set of gang tools in the side head. A table speed of 16 r.p.m. is used for the second operation and the feed for the grooving tools is .007 in. The third operation consists of finishing the rough end of the tub for the first ring with the side head, for which a table speed of 22 r.p.m. and a feed of .113 in. is used. The fourth and final operation is the parting of the rings with the parting tool in the main head set by a micrometer dial. As each ring is cut off it is held in a special ring-holding

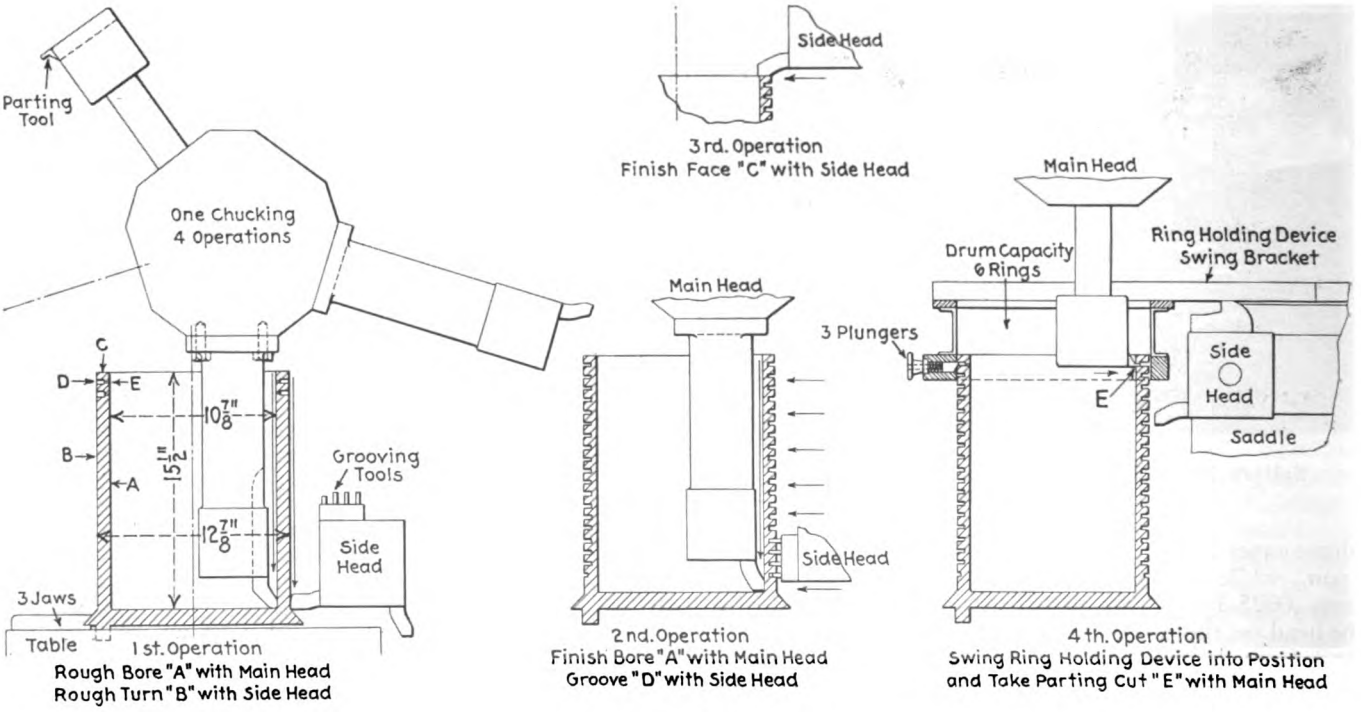


Fig. 3

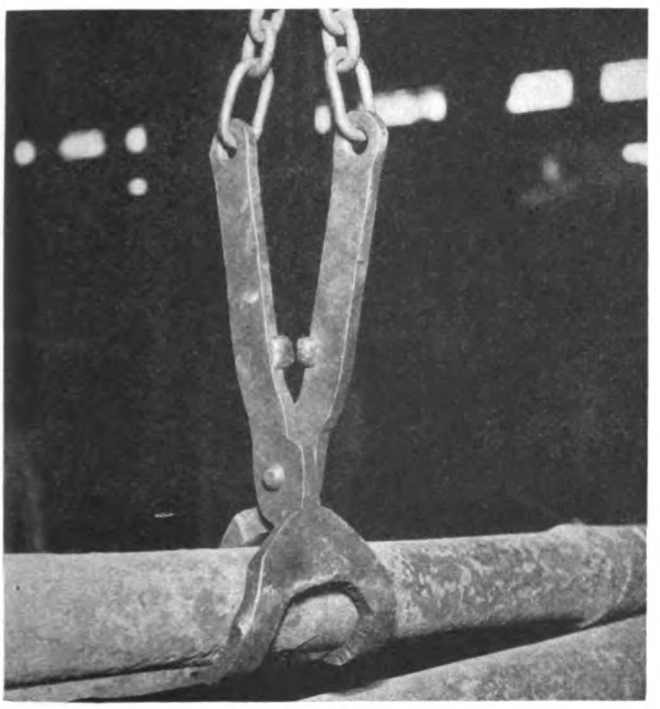
a table speed of 60.2 r.p.m. and a feed of .033 in. The time involved in the work in connection with the second chucking of this bushing is 4 min., making a total time for complete finishing of the bushing, floor to floor, 10 min., which includes setting up and removing the work

device mounted on a swing bracket on the side head.

The entire time involved for setting up the packing tub, machining and removing the rings is 1 hr. 35 min. for the finishing of 19 rings, or an average of 5 min. per ring. The material used is cast iron.

Safety Tongs for Round Materials

A SPECIAL pair of tongs which have proved very satisfactory for handling piston rods, small axles, steel tubes and other round material is shown in the illustration, the construction being clearly indicated.



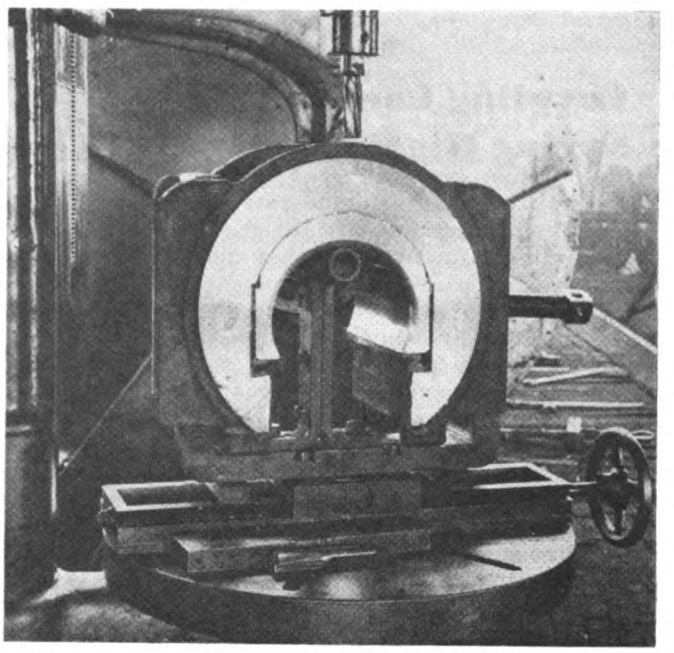
Safety tongs used in handling heavy round material with a minimum of chance of personal injury

Owing to the pointed and relatively thin construction of the tong jaws, they can be readily applied around the axles even when the latter are rolled closely together on the shop floor or storage rack. The action of the hoist on the double chain connected to the tong handles prevents any possibility of the axle dropping during the lifting operation or at any time while the weight of the axle is supported by the tongs. As a safety precaution against pinched fingers in handling these tongs, it will be noted that a metal stop is electric-welded to each handle in such a way as to prevent the tongs' closing beyond a certain point.

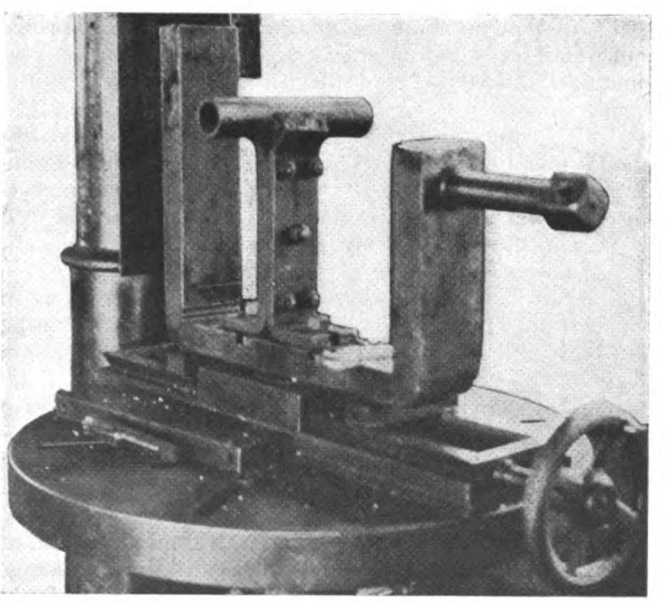
Milling Worn Driving-Box Saddle Seats

THE use of a convenient fixture and end mill for truing worn driving-box saddle seats is shown in the illustration. The fixture, which was developed in the Clinton (Iowa) shops of the Chicago & North Western, is applied to the table of a conventional drill press and used for refinishing saddle seats square with the shoe and wedgeways, square with the axis of the crown bearing and at a standard distance from the bearing center.

Worn saddle-bearing seats having been built-up by electric welding, the driving box is applied on the fixture, as shown in the illustration, and an end mill inserted in the drill press spindle. Cross feed is provided by means of an old planer crossbar, bolted to the center of the drill table. A heavy U-shaped frame, made of 2-in. by 5-in. steel, with the left leg 20 in. high and the right leg 14 in. high, is bolted to the tool post rest, being moved on the sliding ways of the crossbar by turning the feed screw. The two legs of the U-frame are spaced



Fixture for milling worn driving-box saddle seats on a drill press



View of the milling fixture before the driving box is put in place

20 in. apart to accommodate the larger size driving boxes and the right leg is drilled and tapped to accommodate a 2-in. V-thread screw.

The weight of the driving box is supported on a horizontal piece of 2-in. pipe, 12 in. long, welded to a double bar support bolted to the bottom of the U-frame. This holds the driving-box crown bearing parallel with the drill table and, when the 2-in. screw is tightened, the

box is forced against the longer leg of the U-frame, thereby holding the shoe and wedgeways accurately perpendicular. Operation of the end mill to machine the built-up seats for the driving-box saddles then produces true surfaces which are square with the shoe and wedgeways and with the bore of the crown bearings. The solid-flute end mill is 1¼ in. in diameter, and made of high-speed steel.

Leveling Locomotive Spring Rigging

WHEN the springs and carrying-gear of a locomotive are properly designed and applied, the rigging will remain level in service until some abnormal condition develops, such as worn pins and bushings, a collapsed spring, or a change in diameter of wheels. The fundamentally sound method to follow in leveling spring rigging is to determine, in each case, the cause of the abnormal condition which has thrown the rigging out of level and correct that condition, rather than to promiscuously shorten or lengthen spring hangers.

The first requisite of level springs and spring rigging is proper design of springs, equalizers, hangers, etc. In order to produce proper designs of these parts, the draftsman must know accurately the total spring-borne weight of the locomotive and the center of gravity of this weight. From this information he can determine the loads to be supported by each of the various springs and arrange the system of equalization accordingly.

Each spring should be tested before application to prove that it will stand at the specified height under the load to be carried, and this test should be repeated at each subsequent shopping of the locomotive. Springs which fail to stand at the specified height under load should be disbanded and the leaves retempered in the spring shop.

With springs and rigging properly designed and applied, the subsequent work of maintaining spring rigging in a level condition consists of singling out and correcting worn or defective conditions as they occur, as well as in compensating for changes in diameters of wheels, etc.

The best method of correcting conditions due to worn pins and bushings consists of renewing the defective parts. The best method of compensating for discrepancies in diameters of wheels, worn bearings, journals, etc., depends so much upon the construction of the locomotive that they can not be dealt with accurately in a broad general discussion of the subject. There are, however, a few fundamental rules which can be followed in practically all cases. These are:

(a) See that specified minimum clearances are maintained between frame rails and the tops of driving boxes, as well as between the driving boxes and the pedestal binders.

(b) The height of couplers and frames above top of rail should vary within the permissible limits according to the amount of wear on tires and wheels. The height of these parts should be the maximum only when wheels and tires are of full diameter. Do not try to maintain locomotive frames and couplers at maximum height from the rail under all conditions.

(c) Avoid, as far as possible, the use of thin tires or small diameter wheels on front or trailing trucks with full diameter tires on driving wheels, or vice versa. Unavoidable discrepancies in diameter between driving and truck wheels may be compensated for by various means without resorting to the lengthening or shortening of spring hangers in the blacksmith shop. The use of false spring seats under driving and trailer truck springs affords a convenient means for compensating for tires of reduced thickness. Liners inserted between male and female center plates of front trucks of the four-wheel type usually serve to compensate for reduced diameter truck wheels.

(d) When locomotives are shopped for repairs, adjustments should be made to compensate for worn conditions of axles, brasses, etc., whereby each spring seat will be carried at the specified level with respect to the plane of axle centers. These adjustments can usually be made to advantage by varying the height of driving spring saddles.

(e) When spring rigging gradually becomes cocked, due to wear on bushings, pins, hanger gibs, spring clips, etc., or to one or more weakened springs, the parts at fault should be renewed or properly repaired.

(f) Do not move equalizer fulcrum pins from their specified location or alter the length of equalizer arms. Changes of this nature disturb the distribution of weights and generally result in the overloading of certain springs and bearings. In order to avoid the possibility of mistakes of this nature, it is a good plan to plug up or blank all holes in equalizer fulcrum castings except those that are authorized for use.

Threading Machine for Maintenance Work

A NEW combination pipe and bolt threading machine, named the "Little Landis," has been brought out by the Landis Machine Company, Waynesboro, Pa. The machine is of the lathe type in which the work is revolved and is designed to thread, ream and cut off pipe and to thread bolts, rods, etc. It is



"Little Landis" combination pipe and bolt threading machine

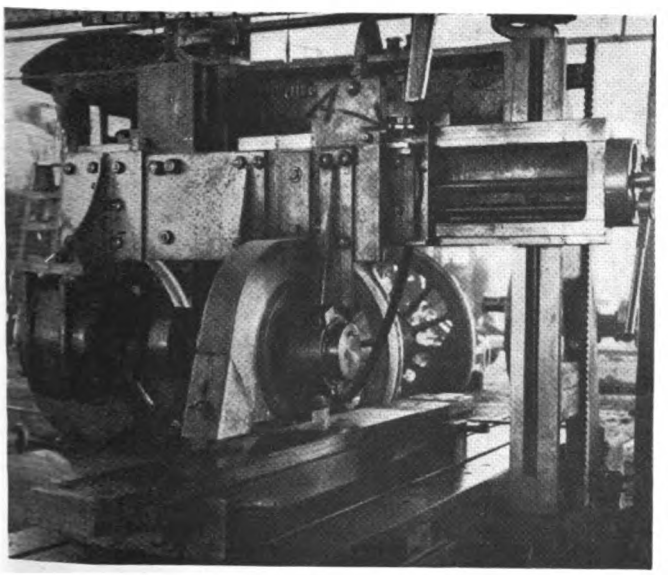
designed for light weight, quick set-up changes and economical operation.

It is driven by a 1-hp. motor of the industrial type, the motor being mounted in an enclosed compartment in the bed and connected to the geared headstock by means of a silent chain drive. A one-piece box type head is employed. The gear box through which three changes of speed are available is cast integral with the spindle housing, thus affording rigidity. All gears are cut and run in an oil bath. The cross rail, which supports the die head and cutting-off and reaming tools, is integral with the carriage. The unit is of sturdy design and is centrally located on the carriage so as to minimize overhang. A scroll chuck of the three-jaw universal type is employed.

The Landis die heads are of new design, combining light weight, rigidity and strength. The heads are of the quick-opening type and have a universal adjustment for size, two die heads having a combined capacity ¼ in. to 2 in. being furnished as standard equipment. By applying bolt chaser holders the 2-in. head can be used for threading bolts from ⅜ in. to 1¼ in. The die heads are adjusted for diameter through a self-locking ratchet screw, the adjustment being universal and quickly made. The setting of the chasers in the holders remains constant for all diameters. The chasers used in the die heads are of the Landis tangential type and are of the same design as those employed in the standard line of machines.

Grinder Attachment For Planer

FOR flat surface-grinding operations, too limited in amount to justify the use of a modern, heavy-duty, single-purpose grinding machine, the attachment illustrated has been adapted for use on a standard planer, being readily applied or removed. The supporting steel framework and brackets, shown in the illustration, are bolted to the two crossfeeds of the planer. The three-horsepower, alternating-current, driving motor is rigidly bolted to one of the brackets and direct-connected through a flexible coupling to the grinding-wheel spindle, which operates in SKF roller bearings and is supported in a housing rigidly bolted to the horizontal supporting plate and crossfeed carriage.



Grinder attachment as applied to an old planer and used for relatively light work

The motor operates at a speed of 1,200 r.p.m., or the same as that of the grinding wheel which is 18 in. in diameter and has a 1½-in. face. Crossfeed of the carriage and grinding wheel is provided by hand, and fine hand adjustment of the vertical feed, to control the depth of cut, is obtained by means of a special fine-thread screw and lock nut, indicated at *A*. A slight change is also necessary in the gear drive of the planer table to give it the same feed forward and backward. A supply of cooling water is provided by means of the hose, illustrated, the stream of water being directed under the grinding wheel.

Pipe-Storage Rack

THE illustration shows a pipe-storage rack which not only provides a convenient and safe storage for pipe of all commonly used sizes, but keeps this pipe off the floor and contributes substantially to the neat appearance of the shop.

The rack consists of four 5-in. steel angles, bolted to the shop wall to serve as vertical supports for the ½-in. by 2¼-in. steel horizontal bars or arms which carry the pipe. These arms, 28 in. long and spaced 11 in. on centers vertically, are forged with the outer end turned up 4 in. to prevent pipe from rolling from the rack, and with the back ends turned down 8 in. in order to provide a rigid, well-braced means of bolting to the upright angles. The rack, itself, is 15 ft. long and provided with four series of horizontal supporting arms. The lower section of the rack is equipped with a 12-gage sheet steel tray to serve as a suitable means for storing short lengths of pipe. The upper outside edge of this tray is turned over slightly as a safety measure.



Pipe-storage rack

Among the Clubs and Associations

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—The annual outing of the Southern and Southwestern Railway Club will be held at Jacksonville, Fla., September 20 and 21.

POWER AND MECHANICAL ENGINEERING.—The Eleventh National Exposition of Power and Mechanical Engineering will be held at the Grand Central Palace, New York, December 3 to 8.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—W. J. Patterson, director, Bureau of Safety, I. C. C., will present a paper on the Activities of the Bureau of Safety at the meeting of the Car Foremen's Association of Chicago to be held on September 10 at 8 p. m. at the LaSalle Hotel, Chicago.

NORTHWEST CAR MEN'S ASSOCIATION.—F. C. Hasse, general manager of the Oxweld Railroad Service Company, will present a paper, accompanied by motion pictures, at the September 10 meeting of the Northwest Car Men's Association which will be held at 8 p. m. at the Minnesota Transfer Y. M. C. A. Building, St. Paul, Minn.

FUEL ASSOCIATION.—The International Railway Fuel Association, with the cooperation and approval of the American Railway Association, has arranged to hold a two-day meeting at the Hotel Sherman, Chicago, on September 17 and 18. The meeting will mark the twenty-sixth year of the association's work on railway fuel and will be the first meeting held by the association in three years, during which important fuel developments have arisen, including increases in fuel costs. The meeting will be addressed by a leading executive of the coal industry, a prominent railway mechanical officer and a representative of the federal co-ordinator, and the program will also include reports of standing committees, as follows:

Front Ends, Grates and Ash Pans
Fuel Distribution and Statistics
Fuel Stations
Inspection and Preparation of Coal
Locomotive Firing Practice—Coal
Locomotive Firing Practice—Oil
New Locomotive Fuel Economy Devices
Steam Turbine and Steam Condensing Locomotives
Storage—Coal
Storage—Oil
Stationary Boiler Plants—Coal
Stationary Boiler Plants—Oil

AMERICAN WELDING SOCIETY.—The fourteenth fall meeting of the American Welding Society will be held at the Hotel New Yorker, New York, October 1 to 5, inclusive. Among the many papers on the tentative program for this meeting are the following three which would appear to be particularly outstanding because of the interest being displayed by the railroads in the use of light-weight steels in passenger car construction: Welding of Cromansil Steel, by H. M. Boylston, Case School of Applied Science; Corrision Fatigue of Welded Stainless Steels, by Wilber E. Harvey, Lehigh University, and Technical Phases of Application of Welding in Hi-Tensile Division of E. G. Budd Manufacturing Company, by M. B. Butler.

WESTERN RAILWAY CLUB.—After a successful season's program of technical papers and addresses, in the course of which its membership has been built up to a total of more than 1,500 railway officers and supply company representatives, the Western Railway Club plans to hold its first annual outing and golf party on September 10 at the Olympia Fields Country Club, Chicago. The entire day will be devoted to a series of games and recreation, including golf, tennis, bridge, etc., with prizes of *all* kinds offered for *all* kinds of players. Dinner in the evening will be followed by a special entertainment, the entire program being designed to afford members and guests a maximum opportunity to fraternize and become better acquainted.

Directory

The following list gives names of Secretaries, dates of next regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, c/o Westinghouse Air Brake Company, Thirty-fourth floor, Empire State Bldg., New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—Division V.—MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASE AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, N. W., Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, Room 332, 30 Church street, New York.

MACHINE SHOP PRACTICE DIVISION.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—Edgar J. Kates, 1350 Broadway, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Jos. A. Andreucetti, C. & N. W., 1519 Daily News Building, 400 W. Madison St., Chicago, Ill. Annual meeting, October 4-5, 1934, Hotel Sherman, Chicago, Ill. Exhibit by Railway Electrical Supply Manufacturers' Association.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, 7926 South Morgan street, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, La Salle Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth street, Council Bluffs, Iowa. Regular meetings, second Tuesday of each month at Council Bluffs.

CENTRAL RAILWAY CLUB OF BUFFALO.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon, 12:15 p. m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha street, Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN.—C. L. Roberts, R. F. D. 5, Peoria, Ill.

RAILWAY CLUB OF GREENVILLE.—Ralph D. Stewart, 21 Sherrard avenue, Greenville, Pa. Regular meeting third Thursday in month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md. Annual meeting October 16-18, Congress Hotel, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TORONTO RAILWAY CLUB.—N. A. Walford, district supervisor car service, Canadian National, Toronto, Ont. Meetings first Friday of each month except June, July, August and September.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—C. L. Emerson, 822 Straus building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

NEWS



THE SEABOARD AIR LINE has awarded a contract to the Ross & White Company, Chicago, for the construction of a fireproof, overhead storage, automatic electric locomotive coaling and sanding plant at Elberton, Ga. The plant is designed to supply coal and sand and remove cinders from locomotives with one stop of the engine.

THE TIMKEN ROLLER BEARING COMPANY has received an order for bearings and boxes for the 25 new baggage cars which the Chicago, Milwaukee, St. Paul & Pacific will build in its shops at Milwaukee, Wis. The J. G. Brill Company, Philadelphia, Pa., has placed with the Timken Company an order for boxes and bearings to be used on four rail motor cars which it is building for the Uruguayan State Railways.

Car on Repair Track Legally Not in Use

A CAR WHICH has reached the repair track for repairs is not "in use" within the Safety Appliance Act. It is out of service and the railroad can take off a handhold or any other safety appliance necessary to effect the repairs without violating the act. The Circuit Court of Appeals, Seventh Circuit, in an action by J. K. Kelley against the New York, Chicago & St. Louis, holds that a field brakeman who was injured by falling from such a car because of the removal of a grab-iron could not recover under the act.

Katy Dismantling 4,551 Cars and Engines

THIS YEAR'S dismantling program of the Missouri-Kansas-Texas, now under way, calls for the dismantling of 4,551 pieces of equipment and the salvaging of more than 60,000 tons of scrap material. The program, begun on April 30, calls for the dismantling of 2,012 coal, 985 stock, 510 automobile, 489 box, 307 ballast and 103 outfit cars, 52 locomotives, 80 passenger cars, including 2 business cars and 13 miscellaneous cars. More than a third of the work has been done, 1,672 pieces of equipment having been dismantled as of July 31. The work is proceeding at the rate of about 15 cars a day.

Railroads Must Bulletin New Labor Law

THE NATIONAL MEDIATION BOARD has issued a general order to the railroads requiring them to post on bulletin boards a notice stating that all disputes between the carriers and their employees will be handled in accordance with the railway labor act and that stated paragraphs of section 2 of the law as amended at the last session of Congress are by law made a part of each contract between carriers and their employees and shall be held binding regardless of any express or implied agreements to the contrary. The paragraphs required to be quoted in the notices are those that representatives shall be designated by the respective parties without influence, interference, or coercion; that employees shall have the right to bargain collectively through representatives of their own choosing; that a majority of any craft or class of employees shall have the right to determine who shall be its representative; and that no carrier shall require any person seeking employment to promise to join or not to join a labor organization, etc.

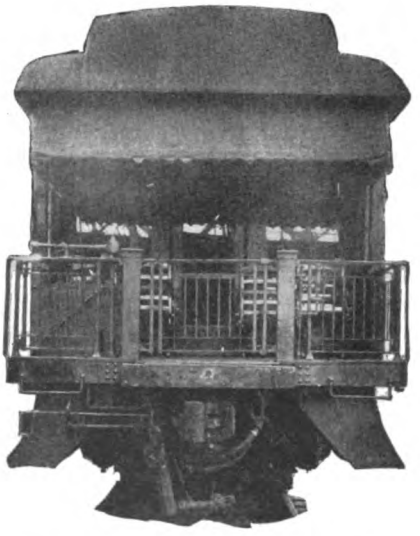
"Railplane" Exhibited at Washington

A DEMONSTRATION of a new system of transportation, known as the "Railplane," was given at Washington, D. C., on August 3. The system was developed in Scotland and the model recently brought to the United States by Alexandre Djakeli of Brussels, who controls the rights and who has granted to J. Carson Adkerson authority to present it to the United States.

The system consists of a single overhead carrier rail from which a streamline car is slung on the traveling trucks. A second rail runs beneath the center of the car for the purpose of limiting the sway of the car and for controlling it on curves. The car is driven by means of air propellers and the system is provided with equipment for signaling, lighting, power distribution and safety devices. The system is proposed to be used independently or in connection with existing railways for high-speed passenger service. The Railplane, it was claimed, will make speeds of from 200 to 300 m.p.h. with safety and comfort at an operating cost of less than 10 per cent of present railway transportation. A short full-sized operating line has been installed at Milngavie, Scotland, for experimental purposes.

Faster Trains Planned Chicago to Twin Cities

THE CHICAGO, BURLINGTON & QUINCY, the Chicago & North Western and the Chicago, Milwaukee, St. Paul & Pacific are planning substantial reduction in the schedules of passenger trains operated between Chicago and the Twin Cities. While the plans are still indefinite, the reductions will range from two to four hours and thus place some trains on 6½ hr. and 9 hr. schedules, as compared with the present schedules which range from 10 hr. 30 min., to 13 hr. 15 min. for route distances ranging from 407 to 431 miles. Part of the program involves the operation of two streamlined, three-car articulated trains by the C. B. & Q. Two such trains, similar to the Zephyr, have been ordered from the J. G. Brill Company, as noted in the New Equipment table elsewhere on this page.



To confirm the feasibility of a 6½ hr. schedule for these trains, the Burlington on July 30 operated its Zephyr from Chicoga to St. Paul, 431 miles, in 6 hr. 4 min., including 6 stops of 1 min. standing time each. Returning, the distance was covered in 6 hr. 10 min., more time being taken for stops. The schedule in detail was as follows:

		Miles	
Left	Chicago	...	9:30 A.M.
Arrived	Aurora	38	10:03 A.M.
"	Savanna	145	11:32 A.M.
"	E. Dubuque	185	12:08 P.M.
"	Prairie du Chien	239	12:52 P.M.
"	LaCrosse	298	1:39 P.M.
"	E. Winona	326	2:00 P.M.
"	St. Paul	431	3:34 P.M.

Average 71 m.p.h.

Chicago-Milwaukee Train Averages 76 M. P. H. Between Terminals

A REGULAR Milwaukee express of the Chicago, Milwaukee, St. Paul & Pacific made the 85-mile run from Chicago to Milwaukee, Wis., in 67 min. 35 sec. on Friday, July 20. The run was made by a standard schedule train, one of the fleet which recently inaugurated a 90-min. service between Chicago and Milwaukee, and by the engine crew which handles the train each day. The train consisted of the following cars:

	Weight, tons
Baggage car	68.6
Parlor car	83.1
Coach	75.8
Coach	72.9
Business car	88.1

The locomotive—a 4-6-4 type with 26-in. by 28-in. cylinders and a tractive force of 45,882—weighed 653,650 lb. with its

tender, making a total train weight of 388.5 tons. All of the cars and the tender and trailer trucks of the locomotive were equipped with Timken roller bearings.

The run was made over relatively level track with few curves. Curves of 1 deg. were negotiated at 102 m.p.h. with little discomfort in the rear car.

The train left Chicago at 9 a.m. and arrived in Milwaukee at 10:07:35 a.m., the run in detail being as follows:

Stations	Distance, miles from Chicago	Distance, increment, miles	Time increment, min.	Time increment, sec.	Speed between stations, m.p.h.
Chicago					
Western ave. ...	2.9	2.9	6	35	26.4
Pacific Junction	5.4	2.5	3	02	49.3
Healy	6.4	1.0	0	51	69.9
Grayland	8.2	1.8	1	33	69.15
Mayfair	9.0	0.8	0	49	58.0
Forest Glen ...	10.2	1.2	1	08	63.0
Edgebrook	11.3	2.1	1	52	67.0
Morton Grove..	14.3	2.0	1	20	89.6
Golf	16.2	1.9	1	11	96.0
Glenview	17.4	1.2	0	50	96.6
Techny	20.2	2.8	2	06	80.0
Northbrook	20.9	0.7	0	31	80.3
Deerfield	23.9	3.0	2	05	86.4
W. Lake Forest	28.0	4.1	2	36	94.4
Rondout	32.3	4.3	2	41	95.7
Wilson	36.8	4.5	2	58	90.9
Gurnee	38.6	1.8	1	14	86.8
Wadsworth	42.9	4.18	2	34	97.44
Russell	47.0	4.1	2	39	94.5
Ranney	51.6	4.6	2	57	93.2
Truesdell	52.6	1.0	0	45	79.2
Somers	57.5	4.9	3	18	88.8
Sturtevant	61.8	4.3	2	58	86.5
Franksville	66.0	4.2	2	46	90.8
Caledonia	69.4	3.4	2	13	91.8
Oakwood	72.8	3.38	2	04	97.97
Lake	77.9	5.1	3	12	95.5
National ave...	84.1	6.2	5	58	62.1
Milwaukee	85.0	0.9	2	49	19.0

The highest speed attained was between Oakwood and Lake when the speedometer registered 103.5 m.p.h. Various sustained speeds on the run were:

	Distance, miles	Time, min.	Time, sec.	Speed, m.p.h.
Chicago to Milwaukee..	85.7	67	35	76.07
Mayfair to Lake	68.9	45	58	89.92
Edgebrook to Oakwood..	61.4	39	46	92.62
Caledonia to Oakwood..	3.38	2	4	97.97
Gurnee to Wadsworth...	4.18	2	34	97.44

National Board of Adjustment Formed

FORMATIVE meetings of the National Railroad Adjustment Board, created by the bill to amend the Railway Labor Act, which bill was passed as one of the final measures of the last Congress on June 18, were held in Chicago on July 30 and 31. These meetings were for the purpose of confirming the personnel of the board and to establish the organization and prepare for its early functioning.

The board will operate under four divisions, each more or less of an individual unit, but all with headquarters in Chicago and under the same general supervision. Division 1 will handle train and engine service matters, Division 2 has supervision over shopcraft matters, Division 3 will devote its attention to clerks, maintenance of way, signalmen, telegraphers and dispatchers, and Division 4 will handle matters pertaining to railway employees engaged in marine service.

The railway personnel of Divisions 1, 2 and 3 will consist of two representatives each from the Eastern and Western lines, and one from the Southeastern lines, while Division 4 will have one representative from each of the three regions.

The appointments to Division 2, together with the positions last held, are as follows:

Western Lines: J. A. Anderson, Master Mechanic, C. M. St. P. & P.; C. E. Peck, superintendent of shops, O.-W. R. R. & N.

Southeastern Lines: George H. Dugan, vice-president (Subsidiary Lines), Southern.

Eastern Lines: M. W. Hassett, assistant superintendent equipment, N. Y. C.; A. G. Walther, assistant supervisor of shops, B. & O.

Brotherhoods: Harry J. Carr, general vice-president, Intl. Assn. of Machinists; George Wright, international representative, Intl. B. of B., D. F. & H.; F. H. Knight, assistant general president, B. of R. R. Carmen of America; Chas. J. McGowan, international representative, Intl. B. of B., I. S. B. and H. of America; L. M. Wicklein, general vice-president, S. M. W. I. Assn.

Nearing Half-Way Mark on P. R. R. Improvements

NEARING THE halfway mark on its extensive electrification improvemnt and equipment building program, financed by P. W. A., the Pennsylvania announced on August 17 that more than 12,000 furloughed railroad men are working directly on the project, with weekly payrolls running around $300,000. Orders for materials and supplies for the job already placed in American markets approximate $23,500,000.

It is estimated by railroad and government officials that at least 25,000 men have been given employment on the railroad and in industry as a result of the improvement work.

In the railroad's shops at Harrisburg, Altoona and Pittsburgh, on the fabrication and erection of 7,000 new freight cars under construction by the railroad as a part of the general P. W. A. improvement program, at a peak 2,501 men were employed. The present weekly payroll is $60,000. Of the total order 4,972 cars have been completed. More than 147,000 tons of steel and 16,600,000 feet of lumber are required for the car construction project.

Hundreds of additional men are engaged in the construction of 28 electric passenger locomotives for service on the New York-Washington line, both in the Altoona Shops of the railroad, where eleven of these engines are being assembled, and in the plants of the electrical companies. Work is also going forward on fifteen switching engines for the new line.

New Equipment

CAR ORDERS

Road	No. of cars	Type of car	Builder
C. B. & Q.	2[1]	3-car articulated trains	Edw. G. Budd Mfg. Co.
General American Trans. Co.	5[2]	60-ton Dry-Flo tank	Own shops
G. M. & N.	2[3]	3-car non-artic. trains	American Car & Fdry. Co.
	1[3]	Streamlined coach	American Car & Fdry. Co.
Hooker Electrochemical Co.	4	30-ton tank	American Car & Fdry. Co.
	4	30-ton tank	General American Tank Car Corp
Seaboard Air Line	100	70-ton phosphate	Pullman Car & Mfg. Corp.

CAR INQUIRIES

Woodward Iron Co.	60	50-ton ore	.....

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of locomotive	Builder
Seaboard Air Line	5[4]	2-6-6-4	Baldwin Loco. Wks.

LOCOMOTIVE INQUIRIES

Illinois Central	11[5]	Diesel	.....
Pittsburg, Shawmut & Northern	2	2-6-6-4	.....

[1] These two additional high-speed, streamlined, three-car articulated trains will be similar to the "Zephyr," but will not carry mail, the additional space gained through the elimination of the mail compartments being given over to the accommodation of additional passengers. Other changes will be principally of a minor character. The trains are to be placed in regular daylight service between Chicago and Minneapolis-St. Paul, Minn., between which points they will operate in opposite directions daily.

[2] To be leased to B. J. Babbitt Co., Albany, N. Y., for transporting silica sand.

[3] These cars, seven in all, are to be fully streamlined and of the non-articulated type. A lightweight alloy steel, U. S. S. Cor-Ten, will be used. The entrance and exit will be in the center, rather than at the end as in conventional standard equipment. Closures between the cars will be flush with the outer contours of the cars to obtain the proper streamlined effect. The first car, comprising the power unit, will have a 600-hp. Diesel-electric engine and mail and baggage compartments. The center coach will contain a passenger compartment and a buffet kitchen, from which meals will be served throughout the train. The third car will be a sleeper-observation car, providing a stateroom and six upper and six lower berths. The rear end of this car will be an observation chair compartment. The cars will be completely air-conditioned, and indirect lighting will be featured throughout.

[4] This is a conditional order.

[5] To be purchased with P. W. A. allotment. The locomotives will be for switching service.

Supply Trade Notes

THE STANDARD CAR TRUCK COMPANY, Chicago, has been appointed exclusive sales representative of the insulation division of the Luse-Stevenson Company, Chicago.

THE HAROLD E. TRENT COMPANY, manufacturers of electric heating units and electric furnaces, has opened an office at 143 Liberty street, New York, in charge of A. H. Gurtner.

L. F. DUFFY, associated with the Chicago office of the Chicago Pneumatic Tool Company, railroad division, for six years, has been transferred to the St. Louis, Mo., office, 1931 Washington avenue.

THE VILOCO RAILWAY MACHINE COMPANY and the Viloco Railway Equipment Company, Chicago, have taken over the manufacture and sale of the Whelan bi-pass valve, following the death of Eugene B. Whelan.

THE BUHL SONS COMPANY, Detroit, Mich., has been appointed distributors of Toncan iron by the Republic Steel Corporation, Youngstown, Ohio.

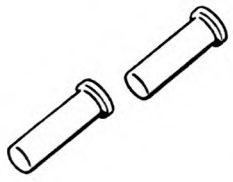
JOHN RANDOLPH & SON, McCormick building, Chicago, have been appointed agents with territory from Chicago to the Pacific Coast, for the Apex Tool & Cutter Company, Inc., Shelton, Conn.

RALPH C. HARDEN has been appointed manager of packing sales in the Mechanical Goods division of the United States Rubber Company. He will be located at the company's main offices, 1790 Broadway, New York City. Mr. Harden during the last 15 years has held several positions with the Johns-Manville Sales Corporation, the latest of which was western regional vice-

(Turn to next left page)

REPAIR THE OLD LOCOMOTIVES WITH MODERN MATERIALS





Toncan Iron Boiler Tubes Pipe Plates Culverts Rivets Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel . . . The Birdsboro Steel Foundry & Machine Company of Birdsboro, Pa. has manufactured and is prepared to supply under license, Toncan Copper Molybdenum Iron castings for locomotives

Many locomotives built years ago are now in the shops preparing for future service. » » » Modernize them at least to the extent of using longer life, up-to-date materials. » » » Use Agathon Staybolts with their superior toughness and shock resistance; Toncan Iron firebox sheets that resist corrosion and have excellent fatigue resistance. For case-hardened parts select Agathon Nickel Iron, a material with a tough core as well as a hardened surface. » » » These are but a few of the many possible applications of alloy materials for equipment repairs. These and many more will reduce future locomotive repairs and delays in service. » » » Consult Republic concerning modern materials and spend your maintenance money most effectively.

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

AGATHON NICKEL IRON

REPUBLIC STEEL CORPORATION

GENERAL OFFICES YOUNGSTOWN, OHIO

Reg. U. S. Pat. Off.

TONCAN COPPER MOLYBDENUM IRON

president of sales, with headquarters at Chicago.

M. J. CZARNIECKI, general manager of sales of the A. M. Byers Company, Pittsburgh, Pa., has been elected vice-president in charge of sales, succeeding H. W. Rinearson, who has resigned. Mr.



M. J. Czarniecki

Czarniecki entered the sales organization of the Byers Company in 1913. The following year he was assigned to the New York office where he remained until his transfer in 1915 to Chicago. After the war, in 1918, he returned to Chicago as district manager and the following year was transferred to New York, serving as district manager until 1925 when he was appointed assistant general manager of sales, with headquarters at Pittsburgh, Pa. In September, 1930, Mr. Czarniecki was appointed to the newly created position of manager of tubular sales and subsequently was appointed general manager of sales.

ROBERT D. BARTLETT has been appointed general manager of the Franklin Steel Works, Chicago, a subsidiary of the Chicago Railway Equipment Company. Mr.



Robert D. Bartlett

Bartlett is a graduate of the law department of the University of Michigan (1907) and was admitted to the bar in Illinois in 1908. For 10 years he was identified with the New York Central Lines and the United States Railroad Administration in legal and operating capacities. In 1920 he became general manager of the Empire Freight Car Company, Kankakee, Ill., and from 1923 to 1931 was successively secretary and treasurer, assistant to the president and vice-president of the Ryan Car Company, Chicago.

WILLIAM MILLER, senior vice-president of the Pyle-National Company, Chicago, has been elected president to succeed Lawrence H. Vilas who died on July 22. Mr. Miller was born in Hannibal, Mo., on July 3, 1867, and began his railroad career as an apprentice in the Hannibal shops of the C. B. & Q. in June, 1882. In 1885 he served as a journeyman on the M.-K.-T., in 1886 on the Wabash, and in 1887 on the D. & R. G. W. In 1889 he was appointed foreman of shops of the St. Louis-San Francisco, and in 1900 became general foreman of the Colorado Midland. He held



William Miller

the latter position until 1904 when he became master mechanic of the Terminal Railroad Association and the Wiggins Ferry railroad of St. Louis. In 1905 he returned to the D. & R. G. W. as master mechanic and assistant superintendent, and in 1907 was appointed superintendent of motive power of the Western Maryland. In 1908 he left railroad service to become vice-president of the Adreon Manufacturing Company, which position he held until 1910 when he was elected president of the Monarch Pneumatic Tool Company and vice-president of the Standard Railway Equipment Company. He resigned from these positions in 1913 to become vice-president of the Pyle-National Company, and in 1914 was elected senior vice-president.

ANDREW D. HUNT recently resumed his duties as manager of engineering of the South Philadelphia (Pa.) Works of the Westinghouse Electric & Manufacturing Company. Mr. Hunt was appointed to this position in 1926 but in June, 1931, was temporarily transferred to the Chicago office of the company to act as steam specialist for the northwestern district. In October, 1932, he was recalled to the South Philadelphia Works, to serve again as steam service manager, which position he had previously held from 1920 until his appointment in 1926 as manager of engineering.

A. E. AINLAY, formerly sales manager of the Midwest Locomotive Works, Hamilton, Ohio, has been appointed sales manager of the newly created locomotive division of the Cummins Engine Company, with headquarters at Columbus, Ind. Mr. Ainlay's engineering experience began in April, 1910, with the Watson Machine Company, Paterson, N. J., and in 1915 he entered the engineering and sales departments of the Bethlehem Steel Company, remaining with that company until 1918.



A. E. Ainlay

The next six years were spent in the engineering departments of the Westinghouse Electric & Manufacturing Company, the Carnegie Steel Company and the Jeffrey Manufacturing Company. In August, 1923, he entered the locomotive field as assistant chief engineer of the Plymouth Locomotive Works, Plymouth, Ohio, later becoming sales manager of that company. In 1930, he went to the Midwest Locomotive Works in charge of sales and engineering.

HERBERT A. MAY, who recently resigned as assistant to the president of the Westinghouse Electric & Manufacturing Company, has been appointed vice-president of



Herbert A. May

the Safety Car Heating & Lighting Company and will have his headquarters in the Gulf building, Pittsburgh, Pa. Mr. May is a director of a number of other industrial companies.

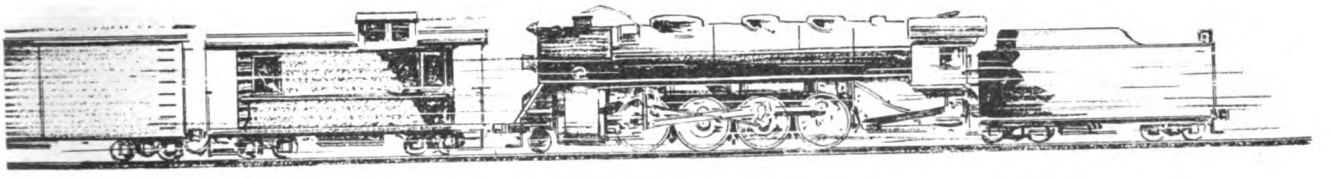
Obituary

GEORGE E. MOLLESON, for many years in the railway supply business at New York, died suddenly on August 14, in the Hotel Earle, New York, at the age of 75.

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Quit Dragging

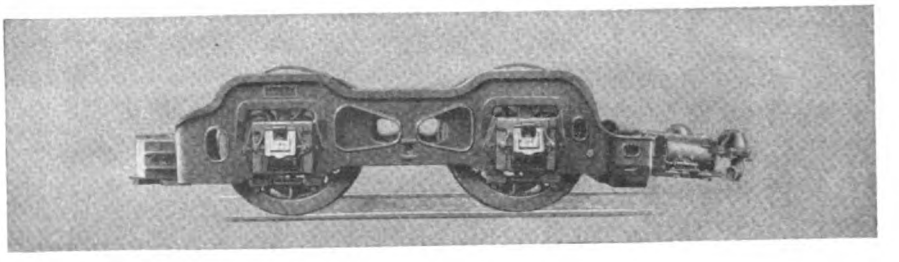
A PUSHER LOCOMOTIVE



Over Every Run

Use of The Locomotive Booster to start the train, and to help over the hard pulls, avoids the need of a lot of excess locomotive weight to be hauled around perhaps 80% of the time, when it is only needed for short periods. The Booster furnishes the extra tractive effort when needed.

Avoiding the need of hauling this excess weight over the road saves a great deal of wear on locomotive parts and saves many maintenance and fuel dollars.



Because material and tolerances are just right for the job, genuine Franklin repair parts give maximum service life.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

Personal Mention

General

J. J. PRENDERGAST, acting mechanical superintendent of the Texas & Pacific, has been appointed mechanical superintendent, with headquarters at Dallas, Tex.

C. F. PARSONS, master mechanic for the New York Central with headquarters at Albany, N. Y., has been appointed assistant superintendent of equipment at New York.

H. C. TREXLER, who has been appointed superintendent of motive power of the Southern, with headquarters at Charlotte, N. C., was born on January 3, 1894, at Rowan County, N. C. He was educated in the public schools and entered railway service in August, 1909, as a machinist apprentice in the Spencer (N. C.) shops of the Southern. He became a machinist in 1913 and in 1919 machinist and erecting shop foreman at Spencer. Mr. Trexler was appointed shop superintendent in 1924, and in November, 1926, master mechanic at Somerset, Ky. In March, 1932, Mr. Trexler became master mechanic at Spencer, from which point he was transferred to Charlotte as superintendent of motive power.

Master Mechanics and Road Foreman

A. D. BINGMAN has been appointed master mechanic for the New York Central with headquarters at Albany, N. Y.

I. L. WAGNER has been appointed assistant road foreman of engines of the Philadelphia division of the Pennsylvania.

H. C. VINSANT, district foreman of the Texas & Pacific at Big Spring, Tex., has been appointed master mechanic, with headquarters at Ft. Worth, Tex.

F. W. BOARDMAN, master mechanic of the Texas & Pacific at Fort Worth, Tex., has accepted the position of master mechanic of the New Orleans Public Belt Railroad, with headquarters at New Orleans, La.

J. B. RAMBO, assistant road foreman of engines of the Pennsylvania, Eastern Region, has been appointed assistant trainmaster and road foreman of engines of the Philadelphia division.

Car Department

T. E. ANDERSON, car foreman of the Texas & Pacific at Ft. Worth, Tex., has been appointed general car foreman, with headquarters at Marshall, Tex.

LUTHER L. YATES, who retired as general superintendent car department of the Pacific Fruit Express on October 1, 1932, died at Monte Rio, Cal., on August 4.

Purchasing and Stores

WESLEY A. CLEM, assistant purchasing agent of the Reading, with headquarters at Philadelphia, Pa., has been appointed purchasing agent for that road and the Central of New Jersey, with the same headquarters.

A. R. MULLENS has been appointed assistant general storekeeper of the Oregon Short Line, the Oregon-Washington Railroad & Navigation Company and the Los Angeles & Salt Lake (all units of the Union Pacific System), with headquarters at Pocatello, Idaho.

JOHN D. LANDIS, purchasing agent of the Reading Company, with headquarters at Philadelphia, Pa., has been appointed assistant to president of that road and the Central of New Jersey, with the same headquarters. Mr. Landis wil lhave supervision over purchases and stores matters for both roads. Mr. Landis was born in Chester County, Pa., on June 29, 1859. He entered the service of the Reading as rodman in the engineering department in 1879. Two years later he was appointed chief clerk in the same department and in January, 1894, he became assistant purchasing agent. Mr. Landis was promoted to the position of purchasing agent in April, 1897. In July, 1918, he was appointed a member of the 'Regional Purchasing Committee of the United States Railroad Administration and the following year he again became purchasing agent for the Reading.

Obituary

EUGENE B. WHELAN, Omaha, Neb., died in that city on July 22 after a short illness. Prior to 1920 Mr. Whelan was employed in the mechanical departments of the Union Pacific, the Minneapolis & St. Louis and the Terminal Railroad of St. Louis, while during the last 14 years he devoted his entire time to the sale of the Whelan bi-pass valve.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

PACKINGS.—Over 60 different types of packings are described and illustrated in a 48-page catalog issued by Johns-Mansville, 22 East Fortieth street, New York.

ROLLER BEARINGS.—Catalog 12, issued by the Shafer Bearing Corporation, 6501 W. Grand avenue, Chicago, covers a wide variety of self-alining roller-bearing units for industrial and machine applications.

DIE HEADS.—General Purpose H & G self-opening die heads are described and illustrated in an 8 page bulletin issued by the Eastern Machine Screw Corporation, New Haven, Conn.

PYROMETERS.—The Illinois Testing Laboratories, Inc., 141 West Austin avenue, Chicago, has issued Bulletin No. 1727 describing "Alnor" pyrometers for measuring surface temperatures of either metallic or non-metallic materials.

POWER TRANSMISSION PRODUCTS.—The Boston Gear Works, Inc., 151 Lafayette street, New York, lists in Catalog 50 such power transmission products as gears, speed reducers, chain drivers, ball bearings, etc.

PNEUMATIC TOOLS.—"The World's Most Popular Pneumatic Tools" are listed in the eight-page bulletin (2037-A) issued by the Ingersoll-Rand Company, 11 Broadway, New York. The new sizes of Multi-Vane drills and Multi-Vane push-throttle screw drivers and nut setters are listed for the first time in this bulletin.

WELDING INFORMATION.—The Linde Air Products Company, New York, has issued two booklets. The first, an eight-page pamphlet entitled "Oxwelding Corrosion-Resisting Steels," contains much instructive data on welding stainless and alloy steel. The other, a twelve-page pamphlet entitled "Design of Jigs and Fixtures," deals with the design of jigs and fixtures for welding. This pamphlet is fully illustrated.

PLUG TYPE VALVES.—An eight-page illustrated booklet descriptive of plug type "Ferrenewo" and "Renewo" valves for throttling, drain and other service requiring maximum resistance to destructive action on valve-seat bearings has been issued by the Lunkenheimer Company, Cincinnati, Ohio.

BYERS GENUINE WROUGHT IRON PLATES.—The A. M. Byers Company, Pittsburgh, Pa., has published a 16-page attractively printed booklet bearing this title which shows the many applications of Byers genuine wrought iron plates and sheets. A considerable part of the space in the booklet is taken up by a large number of photographs illustrating the various ways that these plates and sheets have been used.

INGACLAD STAINLESS STEEL.—A 16-page booklet entitled "Manual of Welding and Fabricating Procedures for IngAclad Stainless Clad Steel" has been issued by the Ingersoll Steel & Disc Company, 310 South Michigan avenue, Chicago. The booklet takes up, step by step, the various methods of welding, soldering, lock seaming, riveting, heat treating, etc., encountered in fabricating products of stainless clad steel and contains many diagrams to guide the fabricator in working with the material.

LINDE PRODUCTS.—"101 Uses for the Air-Acetylene Flame" and "The Maintenance of Reciprocating Parts" are the titles of booklets issued by the Linde Air Products Company, 205 East Forty-Second street, New York. The former, which points out that the air-acetylene flame does not take the place of the oxy-acetylene flame but serves as a supplementary tool for use where lower flame temperatures are required, describes the outfits necessary where soldering, brazing or heating operations are involved. The latter booklet deals with the application by the oxy-acetylene process of wear-resisting bronze to the wearing surfaces of sliding parts.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices, 30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: **Terminal Tower** Washington: 832 National Press Bldg. San Francisco: **58 Main St.**

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Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States and possessions: 1 year, $3; 2 years, $5. Canada, including duty: 1 year, $3.50; 2 years, $6. Foreign countries: 1 year, $4; 2 years, $7.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.



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NEW CONDITIONS



Require NEW FACILITIES

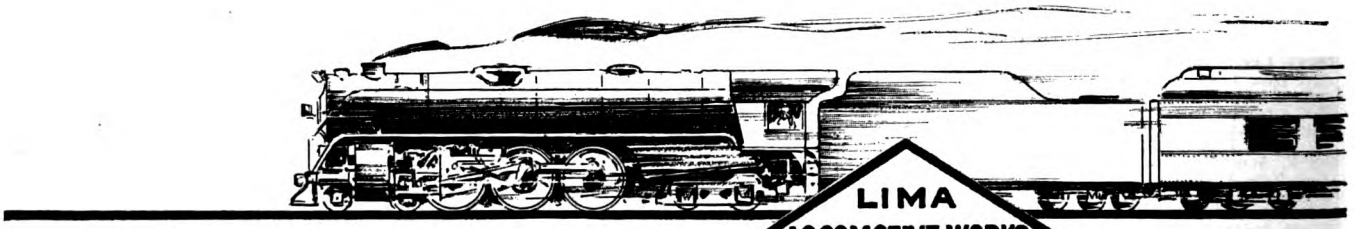
The traveling public and the shipper are both transportation conscious today as never before.

Speed, comfort, convenience, safety are factors that must be provided to attract business.

Efficiency, economy and flexibility are equally essential to show an operating profit.

Only in the steam locomotive can all these factors be provided.

The streamlined Super-Power steam locomotive is capable of providing the highest speed you can use, the greatest hauling capacity and the lowest operating cost with the greatest safety.



LIMA LOCOMOTIVE WORKS INCORPORATED

LIMA OHIO

Railway
Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

October - 1934

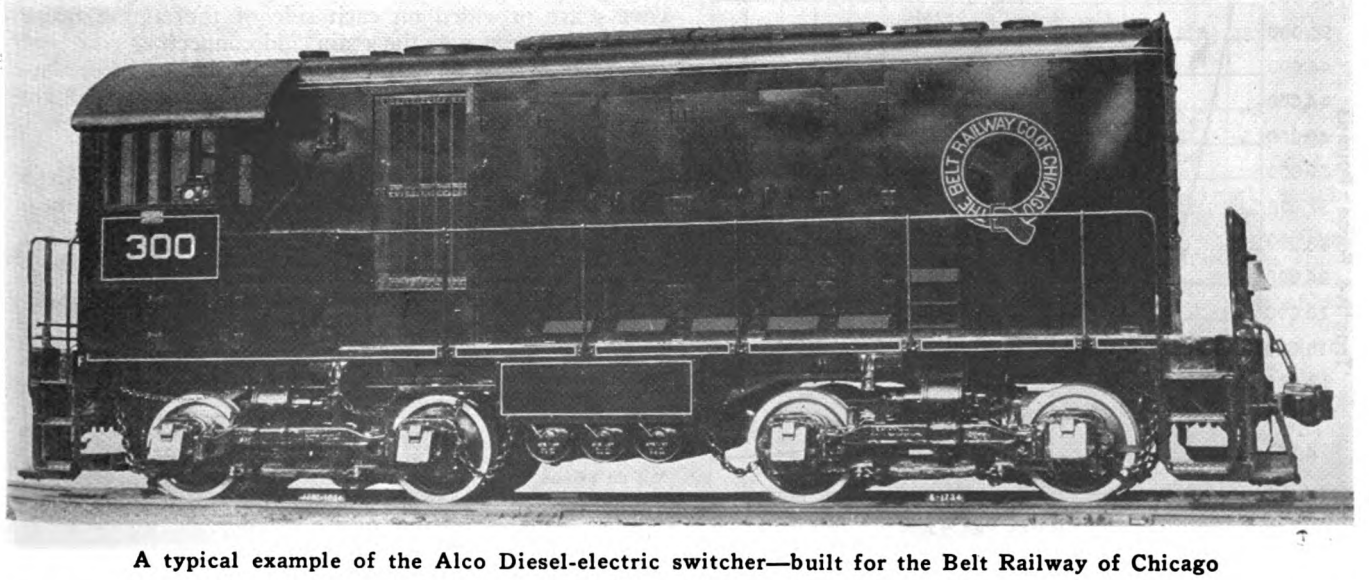
Alco Builds Diesel-Electric Switchers with 600-Hp. Engines

Single-end cab units built from same basic design for several roads are powered with McIntosh & Seymour Diesel engines. Power trucks with two traction motors each have unusual design providing for positive equalization

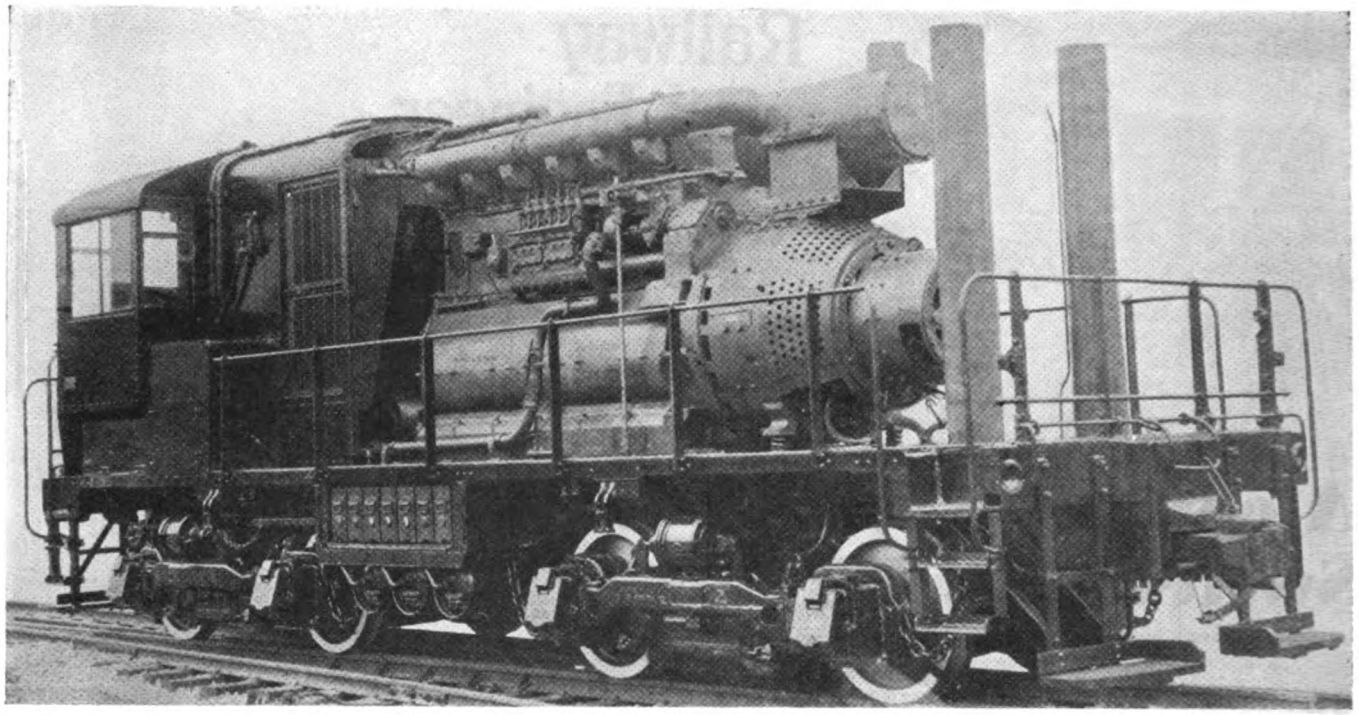
DURING recent months the American Locomotive Company has built several Diesel-electric switching locomotives for different roads having a total weight of 200,000 lb. and a starting tractive force of 60,000 lb. A typical design, built for the Belt Railway of Chicago, is shown in one of the illustrations. One each of the same basic design has been built for the New York, New Haven & Hartford, the Lehigh Valley and the Boston & Maine, and eight have been built for the Lackawanna.

Two four-wheel power trucks having a total of four traction motors carry the entire weight of the locomotive, and the engine and generators, built as a unit assembly, are mounted on underframes either of cast steel or built-up structural design as the preference of the individual roads dictates. The two power trucks and the engine and generator assembly comprise 125,400 lb. of the total 200,000-lb. weight of the locomotive. The general dimensions and the principal weights are given in Table I. The operator's cab is at the end and the equipment hood, covering the engine and generators, is designed to provide maximum visibility for the operator and complete accessibility to important parts. The radiators are under a portion of the hood next to the cab, and the forward hood, covering the engine unit, is readily removable for access to the engine and generators when major shop repairs are necessary.

In 1929 the American Locomotive Company purchased the McIntosh & Seymour Corporation, an old and well-established concern noted for its modern heavy-duty marine and stationary Diesel engines. Through the coordination of the Diesel experience of the McIntosh & Seymour Corporation with the American Locomotive



A typical example of the Alco Diesel-electric switcher—built for the Belt Railway of Chicago



The forward hood is readily removable providing accessibility to the engine and generator. The radiators are seen directly ahead of the cab and the columns at the forward end are the sand boxes

Company's knowledge of general railway conditions of operations and their facilities for maintenance and repair, a special line of Diesel engines peculiarly adapted for railway use was perfected.

The Alco type McIntosh & Seymour Corporation 600-hp. Diesel engine for locomotive service has six cylinders cast in one block and is of the vertical four-cycle, single-acting type. This engine is rated at 600 b.hp. at 700 r.p.m. Its idling speed is one-half of the normal running speed, or 350 r.p.m. Each of the six cylinders has a bore of 12½ in. with a piston stroke of 13 in. These dimensions and a normal speed of 700 r.p.m. give a brake mean effective pressure of 70 lb. per sq. in., and a conservative piston speed of 1,515 ft. per min.

The cylinder block of cast iron is arranged to include water jackets of ample capacity with free circulation. Removable cylinder liners are used in order to protect the cylinder block. The cylinder liners take the wear and may easily be replaced when necessary.

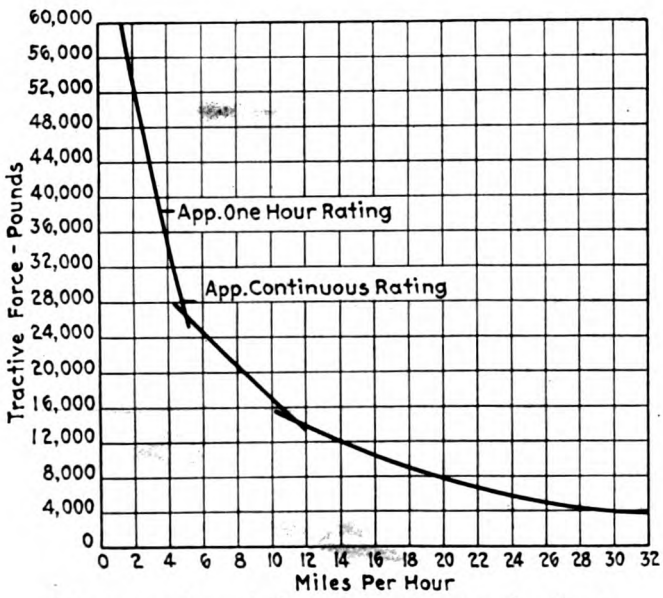


Chart showing relation of speed to tractive force

Individual cylinder heads of cast iron are used. These have a uniform section, are water jacketed and are secured to the cylinder block by heavy studs. Two exhaust valves, two intake valves and one injection nozzle are symmetrically located in each cylinder head. The injection nozzle is located in the center of the cylinder head and is designed to give proper fuel atomization. The valve gear is of the rocker type and is totally enclosed and pressure lubricated. The valve springs are suitable for heavy-duty operation.

The cam shaft is of suitably treated steel with integral cams accurately fitted. The cam shaft may be removed from the engine in one piece. The shaft is rigidly supported and driven from the crank shaft by gears.

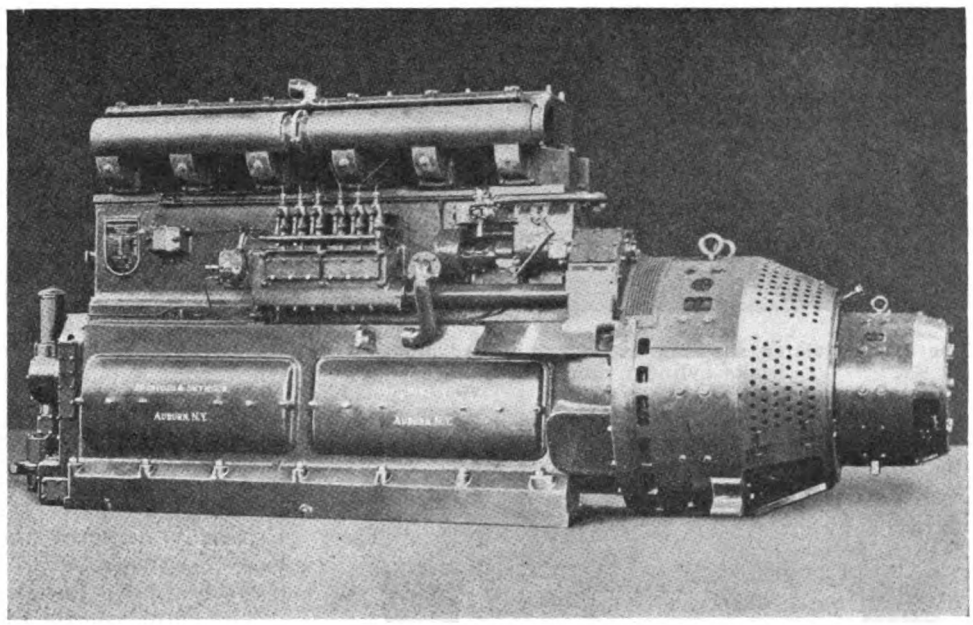
The engine frame is of the integral base type; that is, the frame supporting the engine bearings and the frame supporting the generator is all in one piece. This is of cast iron designed for heavy duty service. Detachable covers are provided on each side of the engine frame, giving free access to the main and connecting rod bearings. These openings are exceptionally large. In the base of the engine frame is a lubricating oil reservoir containing 100 gallons of lubricating oil, which is generally changed every three months.

With this type of construction the total weight of the Diesel engine alone is 35,000 lb., or only 17½ per cent of the total weight of the locomotive which is 100 tons.

The main bearings are rigidly located in the engine

Table I—General Dimensions of Alco Diesel-Electric Locomotive

Length overall, inside coupler knuckles	40 ft. 10 in.
Width, overall	10 ft. 3½ in.
Height, from rail (maximum)	14 ft. 5 in.
Truck-center distance	27 ft. 4 in.
Truck wheel base	8 ft. 0 in.
Truck wheels, diameter	3 ft. 4 in.
Total weight of locomotive	200,000 lb.
Weight of engine, generators and bed	49,000 lb.
Weight of one truck, complete with motors and brake rigging	38,200 lb.
Total weight on drivers	200,000 lb.
Tractive force (starting)	60,000 lb.
Maximum speed	40 m.p.h.
Minimum radius curvature (locomotive alone)	50 ft.



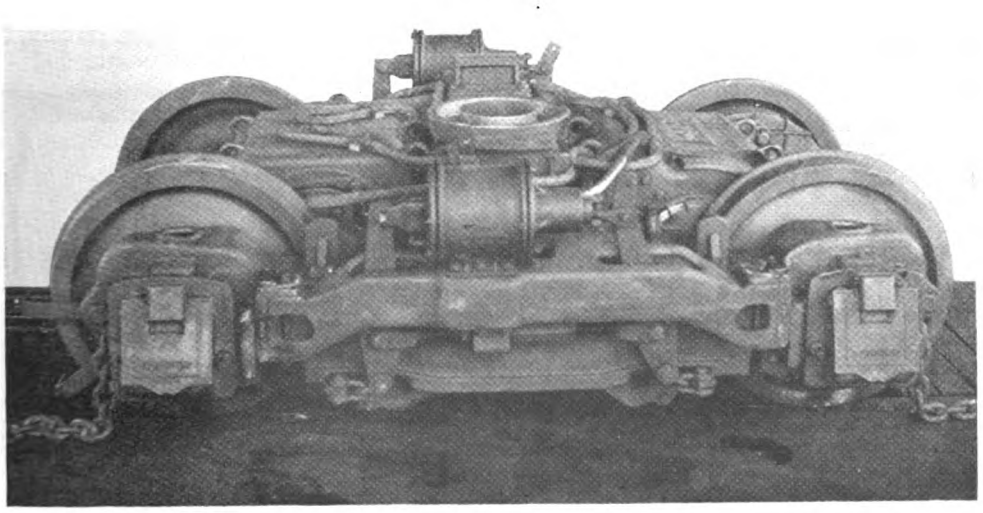
The injection side of the 600-hp. McIntosh & Seymour engine showing the unit pumps which supply fuel to the nozzles. The generators are direct driven from the main shaft

frame. The bearing shells are of bronze and lined with babbitt metal. The bearing caps are of cast steel and accurately fitted. The bearings are bored and reamed with the caps in place. The crank shaft has six throws and is of heat-treated steel accurately fitted in seven main bearings. The crank-pin diameter is 8¼ in. and the length, 6 in. The main bearing diameter is 9½ in. and the length, 5½ in. The engine has an exceptionally large crank shaft, thereby eliminating any serious tortional vibration within the working range.

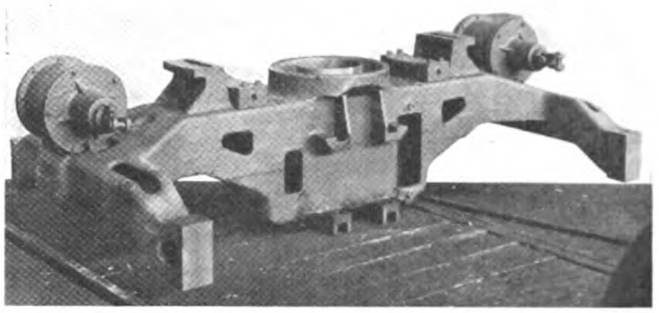
Connecting rods are designed of forged steel. The crank-pin bearing shells of bronze are lined with babbitt metal. Bearing caps of forged steel are accurately fitted to each rod. The piston end of the rod is fitted with a bronze bushing for the wrist-pin bearing. The rods are rifle-drilled to carry lubricating oil from the connecting-rod bearing to the wrist-pin bearing. The floating steel wrist pins are accurately ground to size. The wrist-pin-bearing diameter is 6 in. and length, 5 in. The trunk type pistons are of cast iron and ground to size. The piston rings are of cast iron. There are five compression rings and two lubricating oil wiper rings. This number of rings not only maintains high compression, but also keeps the lubricating-oil consumption down to a minimum.

The lubricating-oil pressure is maintained by a heavy-duty gear type pump located in the base of the oil sump. This oil is forced through the cooling radiator and then through a strainer to the main bearing, then through the crank shaft to the crank pin and on up through the connecting rod to the wrist pin, where it is forced out and drops down to the reservoir. The centrifugal type water pump is mounted on the side of the engine and forces the water through the cylinder jacket out through the top of the cylinder heads to the top of the radiator and returns to the water pump from the bottom of the radiator. The radiator sections for the water cooling and lubricating-oil cooling are mounted in the same unit. The air is forced through this radiator by an electrc motor-driven fan. The fan speed is regulated by the locomotive operator and has four positions—stop, slow, medium and fast.

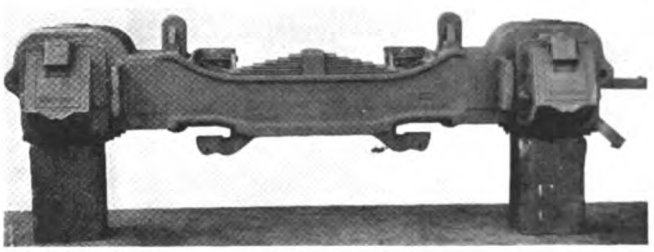
The engine governor is of the centrifugal variable speed type and is mounted on the side of the engine. The operator's throttle lever controls the setting of the governor between idling and full speed. The governor controls the setting of the fuel injection pumps. In other words, the operator has control over the engine speed only, while the governor has complete control over the fuel supply. By this method the engineer is



The complete truck, weighing 38,200 lb., is designed to provide positive equalization regardless of uneven track conditions and, with the brake rigging outside of the side frames, permits brake adjustments and replacements to be made without undue loss of time



The truck bolster showing arrangement for motor and brake cylinder mounting



The truck equalizer is a steel casting housing the spring and forming the journal box pedestals

not only controlling engine speed, but also engine maintenance which is directly proportionate to engine speed, thereby keeping both at a minimum in proportion to the horsepower actually delivered. The fuel injection system is of the Bosch type which uses a separate injection pump for each cylinder. The six pumps are mounted in one unit on the side of the engine opposite the governor. The small cam shaft is used to operate these pumps which have a constant stroke. However, the quantity of fuel is varied by the governor controlling the by-pass valve on each pump. Incorporated with the injection system is an automatic safety device which shuts the fuel off if the lubricating-oil pressure drops below normal. The fuel oil is pumped from the fuel-oil tank from the locomotive up to the fuel injection pump by a small motor-driven fuel pump. The fuel oil is forced by the fuel-injection pump through a special steel pipe to the fuel injection nozzle previously referred to as located in the center of the cylinder head. This system is extremely simple to adjust and maintain, as all pumps are identical and mounted on one base.

An air intake header with suitable air filter is provided. On the other side of the engine is the exhaust header which enters the heavy steel plate muffler.

The Diesel engine has a fuel-oil consumption (based on 19,000 B.t.u. per pound) of 0.41 lb. per brake horsepower per hour at full load; 0.42 lb. per brake horsepower per hour at 75 per cent load, and 0.46 lb. per brake horsepower per hour at 50 per cent load. With this fuel consumption the exhaust will meet any smoke requirement of federal, state and municipal authorities. The fuel oil recommended with this Diesel engine has the following specifications.

Heat value (B.t.u. per pound)	Minimum	18,500
Baume at 60 deg. F	Minimum	26
Flash point, deg. F	Minimum	150
Viscosity Saybolt universal (Seconds at 100 deg. F)	Maximum	60
Water and sediment	Maximum	1 per cent
Carbon residue	Maximum	1 per cent
Sulphur	Maximum	1 per cent

(Fuel oil should be wholly an overhead product.)

Electrical Features

The electrical equipment consists primarily of the main and auxiliary generators and the traction motors. The main and auxiliary generators are overhung from the engine and driven by the main engine shaft. The main generator is a General Electric DT-526 of the differential-field-control type having characteristics especially adapted to switching service. The auxiliary generator is of the constant-voltage type (125 volts) maintaining this voltage regardless of engine speed. This generator furnishes current for the charging of the 56-cell, heavy-duty storage battery for starting the engine as well as power to such auxiliaries as the 100-cu.-ft. air compressor, radiator-fan motor and traction blower motor.

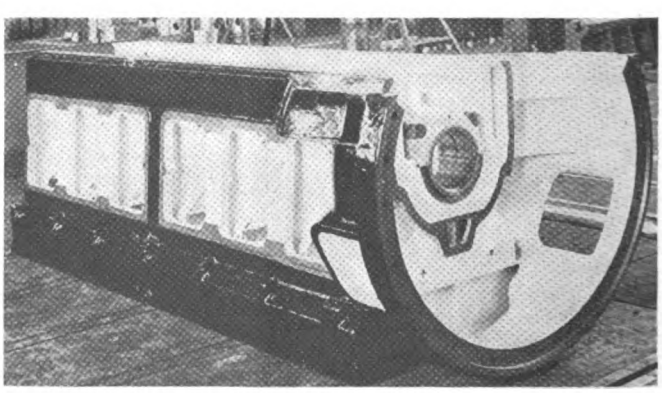
Four single-geared commutating-pole type traction motors, class GE-287, are supported on the truck axles, to assure gear and pinion alinement, and on the truck bolster by means of a motor nose on spring supports. Especially designed for switching service, the motor losses, particularly at high tractive forces, are relatively low per kilowatt of power input.

The entire control of the locomotive is embodied in the operator's throttle which simply regulates the speed of the Diesel engine. Reversal is effected by a master controller. The motors operate in series at low speeds and are automatically changed by a voltage relay to series parallel. By automatically shunting the fields of the traction motors higher running speeds are obtainable, but the operator may forestall the higher running speeds by setting the electrical controller on the series or series-parallel position.

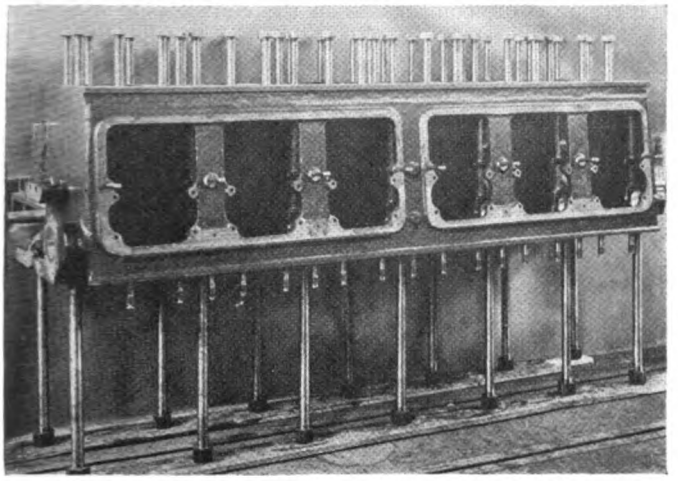
Underframe and Trucks

The underframe generally is of cast steel construction, but some locomotives of this type have underframes fabricated of structural shapes and plates welded into a single structure with cast steel bumpers at the front and rear. Standard A.R.A. couplers and pockets are used.

The power trucks, two in number, are of the four-wheel center bearing type having a special design of cast steel bolster. Each truck equalizer, or what in this case may more properly be termed the side frame, is a steel casting, at each end of which is the truck-box pedestal. Single, long, semi-elliptic springs, one suspended by hangers in each side-frame casting, carry the load. The bolster casting is designed to form the nose mounting for the two traction motors on each truck and supports the two brake cylinders outside of the springs. The ends of the longitudinal side extensions of this casting carry vertical wearing pads bearing against similar pads on the side frames just inside



The crank case and engine bed



The cylinder block

the truck boxes. These keep the truck square in horizontal alinement without interfering with vertical flexibility.

The principal feature of this truck is that the construction provides for positive equalization at all times without the distortion of any truck members regardless of any uneven track condition. The low side frame and absence of end frames allows ready accessibility to the inspection covers and oil reservoirs of the traction motors. The brake rigging is all placed on the outside of the truck so that brake adjustments, inspection and brake shoe renewals can be made with a minimum loss of time.

The axles are of open hearth forged steel finished for truck and motor bearings, wheel and gear fits, and the journals are 7 in. by 14 in. The rolled steel wheels are 40 in. diameter.

Cab and Fixtures

The operator's cab is of the single end type with a removable hood covering the Diesel engine and generator. The fuel oil tanks are of 400 gallon capacity and the cooling water tanks have a capacity of 50 gallon. Four sand boxes are provided and the sand is delivered to the rail by means of pneumatic sanders. Electric cab heaters are provided.

Performance

Of the several railroads on which locomotives of this type have been in switching service for some time, two have furnished data on fuel and oil consumption and maintenance for a full year's operation. On road A the fuel consumption averaged 5.22 gallons per hour and lubricating oil .0696 gallon per hour for a total of 7,609 hours. The locomotive was in the shop 10 days for a yearly overhaul, on which 568⅙ man-hours were expended, of which 257½ man-hours were on the Diesel engine, 249⅔ man-hours on other mechanical equipment, including wheels turned, and 61 man-hours on electrical equipment. On road B the fuel consumption averaged 5.93 gallons per hour and the lubricating-oil consumption .0757 gallon per hour during 8,082 hours of service. This locomotive was in the shop two weeks for its annual overhaul. The Diesel engine accounted for 194 man-hours; other mechanical equipment, including wheels turned, 265 man-hours, and electrical equipment, 112½ man-hours—a total of 571½ man-hours during the shopping.

New Haven Installs Air-Conditioning in 69 Cars

Carrier-Safety units accomplish the distribution of air without the use of ducts

A TOTAL of 69 passenger cars equipped with Carrier-Safety air-conditioning equipment have recently been placed in service on the New York, New Haven & Hartford. Of these 57 are de luxe coaches and smoking cars and 12 are combination baggage and smoking cars. The air-conditioning equipment is electro-mechanical employing a reciprocating compressor and Freon as a refrigerant.

The air-conditioning unit containing the air circulating fan, motor and cooling coils, heating coils, expansion valves and outside and return air filters is located in the clerestory at the center of the car.

Air Distribution Accomplished Without Ducts

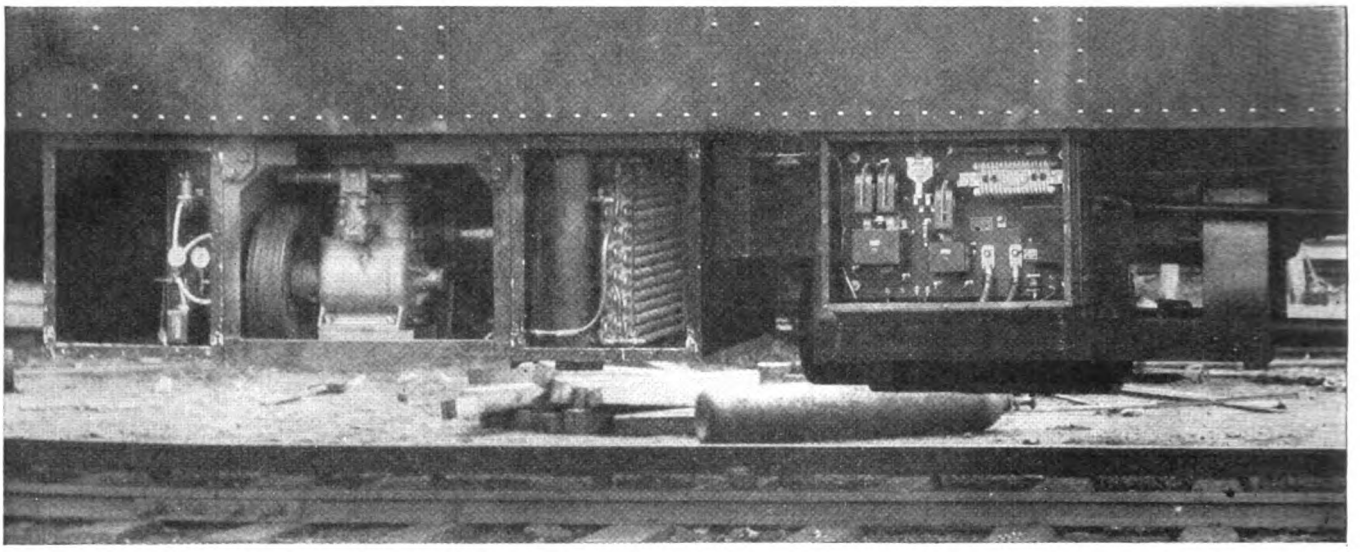
The air distribution in all the cars is by delivery without ducts direct from the air-conditioning units. In the coaches and smokers the air-conditioning unit is placed in the center of the car and delivers air in both directions. In the baggage-smokers the unit is placed on the baggage compartment side of the partition and delivers air in one direction only.

There are two sets of fans in the coach units, driven by V-belts from a single motor. These fans draw air from outside the car through filters, located in the deck-side, and air from the car through filters placed over a grille located under the unit. The air from the fans is forced through the heating and cooling coils, and through the special distribution plate into the car. This plate is so designed that the air issues into the car with sufficient velocity to reach the end of the car, but to cause no objectionable drafts. The units circulate 2400 cu. ft. of air per minute, 600 of which is taken from outside the car.

The air-conditioning units in the baggage-smokers are similar to those in the coaches except that there is only one set of fans and coils. These units circulate a total of 1200 cu. ft. of air per minute. The return air grilles in these cars are mounted vertically in the partition between the passenger and baggage compartments.

Control of the temperature of the cars is accomplished by starting and stopping of the refrigeration unit by means of a thermostat. Heating coils are placed in the

air-conditioning unit so that when the fans are used for circulating air in cold weather the air may be delivered to the car at a comfortable temperature. Control of the car



The refrigerating unit is beneath the car floor

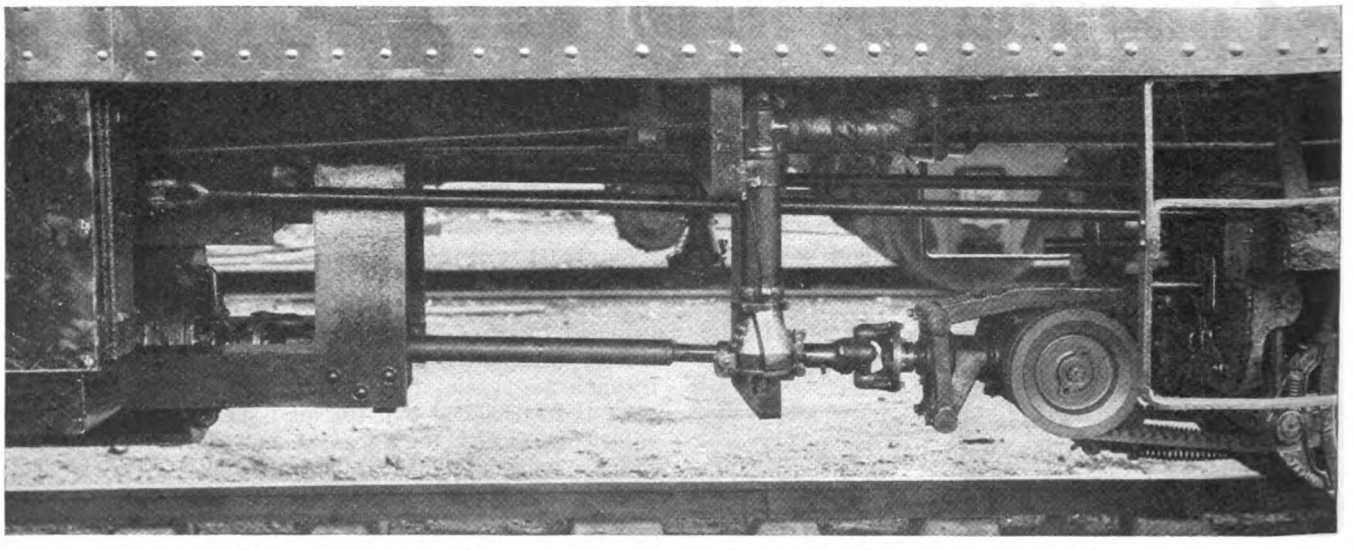
temperature both for cooling and heating is accomplished by the Vapor Car Heating Company's centralized control.

The Refrigeration Unit

The refrigerating unit, composed of the compressor, condensers, condenser fans, liquid receiver and liquid subcooler, with the motor for driving the compressor and condenser fans, is located beneath the car floor. The necessary connecting pipes between these units are run between the car sheathing and the inside finish.

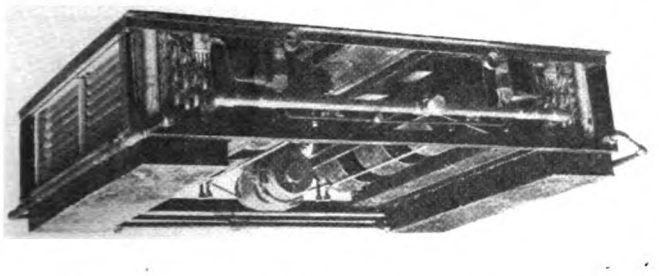
During the operation of the system liquid refrigerant is supplied to the cooling coil in proper amount by the expansion valves. The heat absorbed from the air circulated over these coils by the air circulating fan evaporates the refrigerant.

This refrigerant vapor is drawn off by the action of the compressor, compressed in the compressor cylinder, and delivered to the condenser, where by the reduction in its temperature in the air-cooled condenser tubes, the vapor is liquefied and passes to the condenser. As refrigerant is needed to supply the cooling coil, the liquid passes from the receiver to the expansion valves. Between the receiver and the expansion valves is the liquid subcooler, which further reduces the temperature of the liquid refrigerant. The liquid subcooler is a coil of tubing placed in the air stream from the condenser fan. The condensed water from the circulating air which forms on the cooling coils of the air-conditioning unit is piped to one of the condenser fans, where a slinging device mounted on the motor shaft sprays the water over the subcooling coil. The evaporative cooling thus obtained reduces materially the temperature at which the liquid refrigerant is delivered to the expansion valves.



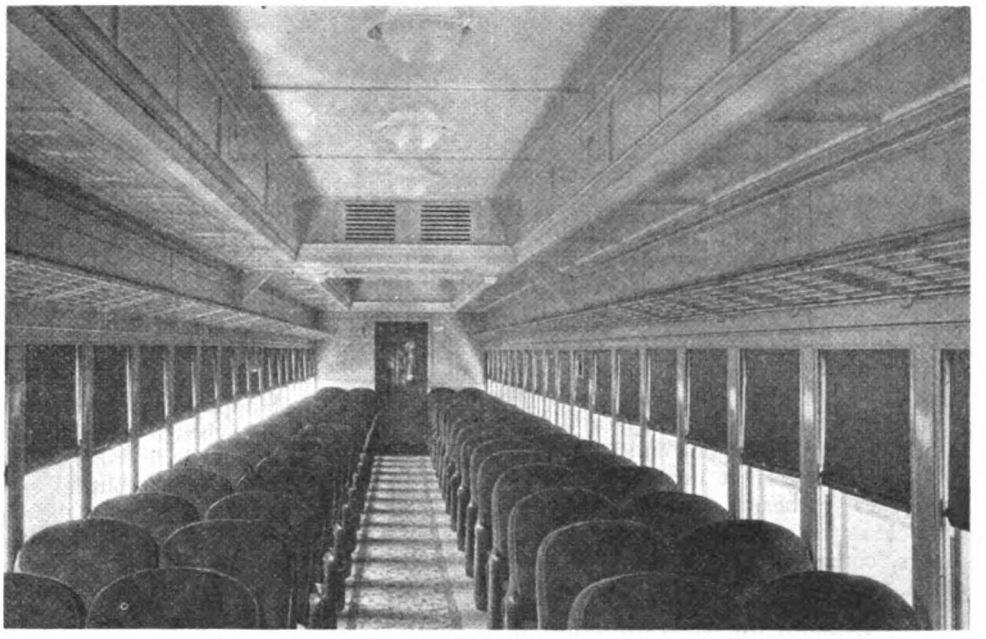
The generator drive from the gear box by means of shaft and universal joints

Liquid subcooling which is a feature of the Carrier-Safety equipment makes a material reduction in the power required by the compressor, since the power



The ceiling unit with cover plates removed

required for a given refrigerating capacity will decrease as the temperature of the liquid delivered to the cooling coil is lowered. With this particular equipment a saving of 10 per cent is said to be accomplished. The compressor is driven from the motor by a multiple V-belt drive. The condenser fans, two for each unit, are mounted directly on the motor shaft. The coaches and smokers have a four-cylinder compressor operating at 300 r.p.m. at normal voltage. The capacity of equipment is seven tons. The baggage-smokers have a two-cylinder compressor operating at 400 r.p.m. and a capacity of five tons.



Interior of the car showing air-conditioning unit in the clerestory

The Power Supply

To supply the power for operating the cooling system and lights, a 15-kw. generator (375 amperes at 40 volts) has been applied to operate in parallel with the 4-kw. generator already on the car. Current for operation when the car is running at low speed or is stationary is supplied by a 1000-amp. hr. storage battery, consisting of 16 cells of Exide EPTT 41. The generator output is controlled by the standard Safety type of carbon pile regulator and relay, with battery protection by taper charge control.

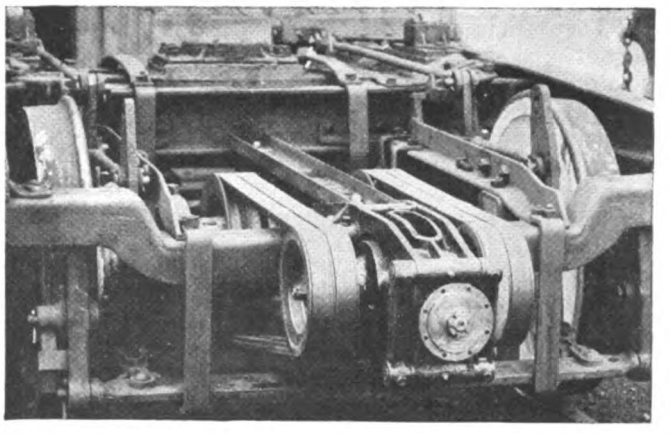
The Generator Drive

The 15-kw. generator is driven from the car axle by a Dayton-Roderwald combination V-belt and gear drive. A pair of driving pulleys, each pulley driving two 2-in. V-belts, is mounted on the axle. These belts drive similar pulleys which are mounted on a shaft extending from either side of a gear box, mounted on the endsill of the truck. This gear box is so arranged that it may swing to keep the proper tension on the belts. Tension is furnished by a spring which swings the gear box away from the endsill.

Mounted in the gear box are bevel gears which transform the rotation 90 degrees, bringing it about an axis parallel to the longitudinal center line of the car. The speed of rotation is increased by the gears from that obtainable by the pulley ratio as limited by considerations of pulley size and clearance, to that necessary for operating the generator. From the gear box, the motion is transmitted to the generator by a driving shaft with universal and slip joints.

The axle pulleys are split and are applied to the axle over a layer of rubber which acts as a bushing. The gear box pulleys are not split, but are applied to taper fits on the shaft. All the pulleys are dynamically balanced.

The type of V-belt permits the use of a connector, making it unnecessary to use endless belts. Applications of the belts are made without the necessity of having an opening in the endsill or of lifting the axle out of the bearing box.



Dayton-Roderwald V-belt gear-box drive applied to the truck

A Clean Collar But No Shirt*



By Jno. C. Dice

Mechanical department employees must do their part in helping to get a square deal for the railroads. Otherwise their welfare will be jeopardized

"WHAT is a public relations program and how is the mechanical department identified with it?" asked a mechanical engineer of a representative who had just returned from a Public Relations Conference.

"The aim is to establish a feeling of harmony between our railroads and prospective passengers and shippers, so that both will benefit," was the answer. "The mechanical department has a part in it, just as every other department has. In big ways and little ways, at work, at home, everywhere, our endeavor should be to cultivate good will, to correct misrepresentation and actively to engage in furthering our railways' interests. The mechanical department ought to be especially alert to these things, considering the important improvements it has made, typical of which is the air-conditioned train."

Slogan for Air-Conditioned Trains

But not all mechanical department employees are so blind to the aims of a public relations program as this one appeared to be. Recently one of them boarded one of his road's air-conditioned trains. Warm, perspiring, crumpled-looking, he hastened to clean up. When he returned he sank with a grateful sigh into his chair, looking well-groomed and serene.

"They ought to allow the mechanical department to suggest a slogan for these trains," he said, "I can travel two thousand miles on them on a clean collar."

"Two thousand miles on a clean collar!"

That is quite a slogan and in it is contained the gist of the railroads' public relations endeavor—to give of their best.

However, a passenger riding in the finest air-conditioned car, free from dirt, on a sweltering day, can be made so uncomfortable and hot under that clean collar by a short-tempered and morose conductor that all of the money spent by the company on equipment for his convenience has been entirely thrown away. The careful planning of the mechanical department and the forethought of the executives who provided this modern comfort, have been absolutely annulled by the careless word, lack of initiative or lack of attention of the company's representative, whoever he may be. No matter how much his road advertises that it is always springtime in these air-conditioned cars, the torrid zone is cool in comparison, from the passengers' viewpoint. Instead of the latest and best in equipment having gained a friend, the stupidity of the human element has added an enemy.

Our fine air-conditioned cars are built to certain standard specifications, but the human element having charge of these trains is not. Each is only an average man, who at times sees no reason why he should have patience with unreasonable people, or display a courteous demeanor, when he does not feel like being bothered. Happily, such treatment occurs only at rare intervals, but when it does, it leaves a slime of discord.

So, apart from equipment that gives the public comfort and establishes safety records, the public relations representative in the mechanical department must realize that it is in his contacts with the public that true understanding is born.

Little Things Count

Men from the mechanical departments have occasion to ride the trains frequently. One was returning recently, apparently relaxed and oblivious to his surroundings. Then he spoke.

"The lamp of that third light isn't of the same composition as the others," he told his companion. "It's too dark. It doesn't look good. When this car gets back to Cincinnati see that it is fixed."

That man knows that the little things make big things and he sees them from the public's angle. He has his job on his mind at all times. He would make a good public relations representative. He loves his job. But many a man who loves his job wouldn't make a good public relations representative. He must do more than love his job. He must understand its relation to the public.

What is this public that he must understand? Is it a reasonable body? Is it always courteous and clear thinking? Has it absolute integrity? Is it unselfish and just? Well, we are a part of this public, you and I, and so is all the rest of this population with its varying interests and its degrees of education and culture, both mental and moral. To work with it in successful public relations endeavors it is necessary to be adaptable, and to give what we would like to receive. When we go into a store we wish to be waited on with courtesy. We

* We have had a number of interesting reactions to the interview with the Public Relations Officer in our August number. Among them is this article by Mr. Dice, who is assistant to vice-president, Chesapeake & Ohio.

wish the upkeep of the store to be attractive and up-to-date. We wish the stock it sells to be up to standard.

But as a part of the public, we know that for all of the satisfaction we expect and have granted us in dealing with that store, if we experience one bit of carelessness or rudeness on the part of even a janitor or delivery boy, we are apt to explode, carry a grudge and declare that we shall never deal there again. The traveling public is just the same, and so is the shipping public, and we must have understanding in dealing with it.

Public Relations Program Must Be Positive

However, to be negative in putting over a public relations program is not what is needed at this time. It is not so much a question of being courteous in order not to make enemies as definitely to cultivate good will in order to make friends.

Friends are needed.

Now, these friends. Wherein are they friends? How may they be recruited?

There are none so bluff, even in this hale and hearty manner of making a living called railroading, who does not know the value of a friend.

A man is a friend when he stops saying, "Yes, the railroads have had a tough time of it," and says instead, "What shall we do to obtain fair treatment for the railroads."

Such friends are among the acquaintances of the mechanical department employee. They belong to his church, his lodge, they gossip with him in the corner store, they are all about him. Some of them may be running for office from his district or know men who are. If he never discusses vital interests with them, they may think of him as the sort who knows no more about his railroad job than that he performs his daily routine.

That man who is running for office. How does he feel about railroad issues? He represents this mechanical department employee in Congress or the state legislature. His work is not sacred. *We* send him to the House or the Senate. Then why does not the mechanical department employee go to him and discuss the problems which the railroads are facing. That is exercising the prerogative of an American citizen. He knows him, or should know him, and he will be glad to know the facts and do the things which common sense business demands. If not, the mechanical department employee and his friends must know someone who will be just and fair. Just as the light in the train that was out of harmony had to be replaced, so should he be replaced with one that will be in better keeping with the best interests of the railroad, the public it serves, and, never overlook this, the best interests of all who work for the railroads.

A robot is a mechanical man but mechanical men are no robots. They can think for themselves. What are they thinking of this threat of government ownership? Is it the other man's job to see that the public is awake to the perils of it and the injustice of it and prevent it? It is the mechanical employees' job that is threatened, along with that of every other employee of the railroads. Therefore, should they not see that their side is represented when this question is brought up? How will their side be represented? Well, whom are they going to elect to office?

The railroads have shown that they are anxious to please and serve the public. This has come about through the shortening of freight and passenger schedules, store-door delivery, and many conveniences and comforts provided the traveling public. The public has accepted these as their just due. A feeling of friendliness toward the carriers prevails. Many editorials have been written by those not connected with the railroads, championing their cause. These facts and others should be known by the mechanical department employee who is anxious to have his railroad represented in the proper light.

What the Railroads Want

All the railroads want is freedom of operation in comparison with their competitors.

They want only what is fair and right.

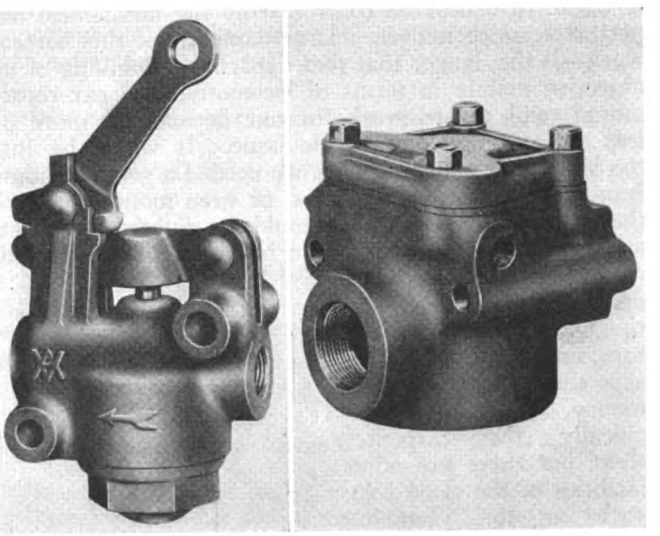
If they are to survive the threat of government ownership, the mechanical department employee and all other railroad workers must constitute themselves public relations representatives and step out and stop it. Unless they wish to obtain their jobs and their promotions through political favor, now is the time to elect men to represent them who will give the railways square legislation.

Here is a program for the mechanical department employee as he makes contacts. Two thousand miles on a clean collar won't help us much if we have lost our shirt.

B-3-B Conductor's Valve And Brake Application Valve

AN improved means of making brake applications by operation of the conductor's valve has been developed by the Westinghouse Air Brake Company to overcome the limitations of previous designs on long cars that have a large brake-pipe volume.

This new scheme involves the use of a large capacity Type E brake application valve, piloted by the B-3-B



B-3-B conductor's valve (left)—Type E brake application valve (right)

conductor's valve. The application valve is installed in a short branch pipe and connected by a small control pipe to the conductor's valve located at a convenient point. Operation of the conductor's valve quickly exhausts the small volume of air in the control pipe and the application valve immediately opens a high capacity vent from the brake pipe to the atmosphere.

Co-operation Between Engineering And Mechanical Departments*

A Chief Engineer talks frankly with the Editor about the possibilities in this direction

THE engineering and mechanical departments have much in common and in many ways can be helpful to each other in the interests of the organization as a whole. Those who are familiar with this series of interviews, which was started more than a year ago, will recall that it is the policy not to advise the person to be interviewed in advance of the nature of the questions in the belief that immediate frank reactions are far more important and to the point for our purposes than more studied and carefully prepared statements. In other words, if the answers are not on the top of the mind and more or less automatic, the suggestions may not be very pressing or vital.

Combine Shop Facilities

"How can the mechanical department co-operate to better advantage with the engineering and maintenance of way departments?" I asked a Chief Engineer and maintenance officer of long experience.

"For one thing," he replied, "it seems to me that it is a mistake, and certainly not to the best advantage of the railroad as a whole, to have the engineering and the mechanical departments maintaining and operating separate facilities to do the same class of work. Take the carpenter shop, for instance. The same kinds of machinery and equipment are required for the work done by both departments, and yet too frequently each department maintains its own shop. One shop could be operated in the interests of both departments more efficiently and with a considerable saving in expense."

"Is it feasible to do this?" I asked.

"Yes," replied the Chief Engineer. "The difficulty in operating one shop for both departments—in which case it would of course be controlled by the mechanical department, since it does a larger amount of this sort of work—is the danger that that department thinking of its objective mainly in terms of locomotive and car repair output, will regard work for our department more or less as incidental and a side issue. It would be just too bad, for instance, if when we needed a set of window frames, we had to wait weeks, or even months to have the order put through. We could not rightly, of course, ask for unusual service, except in emergencies, but with reasonable attention to our needs. Such accommodation should prove satisfactory, and at the same time save the company a lot of money. I mention specifically the carpenter shop, but there are other facilities of the same sort, such as the plumbing shop."

"How about frog and switch work?" I inquired.

"My own point of view, and apparently that of many other chief engineers," replied the Chief Engineer, "is that the manufacturers are much better equipped to handle frog shop work, particularly since we have come to the use of manganese steel, and that it is more satisfactory and economical to have it done by them. There is, however, a certain amount of switch repair work and machinery repairs which is being done by the engineering and maintenance department, which I frankly believe can be handled to much better advantage by the mechanical department, if it will do the work promptly."

"Are there other ways in which the mechanical department can co-operate with you in the best interests of the welfare of the organization as a whole?"

Repair Work Train Equipment

"Yes," replied the Chief Engineer. "Our work train cranes and derricks are valuable pieces of equipment, especially in the busy season, and should be repaired promptly. Unfortunately, for some reason or other, this equipment sometimes has a tough time getting through the repair shop. I know of one road where great improvement was made in this respect when the mechanical department definitely set aside certain facilities and a certain part of the personnel for this work."

"Presumably that is the practice on most roads," I ventured, "at least where there is a sufficient amount of work to warrant so doing."

"It is true in some cases, but not all, by any means," said the Chief Engineer. "I wish also that when the locomotive and car shops are closed down, the shop in which the repairs to our equipment are being made, could be kept open, at least when we have particular need for it."

"Incidentally," continued the Chief Engineer, "there was a time when we had difficulty in getting suitable locomotives for our work trains. I am glad to say that conditions in this respect have changed and the mechanical department takes pride in seeing that we have that class of power which is best suited to the particular operations which we have in hand on a given day."



"What else have you to suggest?" I asked.

"Only one other thing," replied the Chief Engineer, "although I realize that it is a moot point and because of intangible factors it is difficult to make a clear case for the proposal. I would like to see the mechanical department install sectional scales, so that

* Fifteenth of a series of interviews with men outside the mechanical department, commenting in a constructive way upon the possibilities of that department.

we can ascertain accurately the weights on each pair of wheels of the locomotive. I may be all wrong, but it seems to me that if we had this information, adjustments could be made to distribute the weight more uniformly and prevent damage to the track. Certain roads, I understand, do have such scales and feel that the expenditure has been fully justified."

As I thanked the Chief Engineer for the courtesies extended to me, he reiterated that it was not his intention in any way to criticize his friends in the mechanical department.

"Indeed," he said, "I would like to see you interview a mechanical department officer as to how our department can co-operate to greater advantage with his. We, for instance, have the responsibility for such things as water supply and water softening and try to do all we can to be helpful to the mechanical department. It would be interesting, however, to know just what mechanical department officers would say if the editor of your Railway Engineering and Maintenance approached them for their ideas about how we could co-operate with them to better advantage."

Aerodynamics of the Railway Train

By Alexander Klemin*

Part III—Conclusion of a survey of wind-tunnel studies of head-end air resistance of locomotives and trains—General summary and conclusions

Experiments on a French Train

MAURAIN carried out experiments at the Institut Aerotechnique de St. Cyr[1] on a French train composed of a locomotive, tender, coach and box car, as shown in Fig. 11. The relative values obtained are of more interest than the actual coefficients.

Model	Coefficient in the form $K = \frac{R}{V^2}$ and not referred to area
1—Complete train	2.045
2—Complete train with rounded nose (coupe-vent) and a tail piece (fuselage)	1.88
3—Locomotive and tender in presence of the train	1.23
4—Locomotive and tender alone	1.38
5—Locomotive and tender alone with nose-piece	1.31
6—Rear box-car in presence of the train	0.465
7—Rear box-car alone	1.21
8—Rear box-car alone with tail piece	1.095
9—Coach in presence of the train	0.390
10—Coach in presence of the train with tender covered in so as to give it the form of a coach	0.36
11—Coach alone	0.985

These experiments indicate that some improvement can be introduced by only minor modifications. The

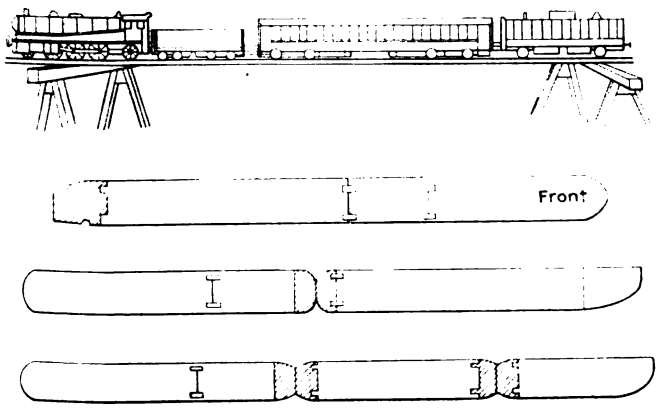


Fig. 11—Maurain's experiments on a French train

effect of the tail piece seems to be more important than that of the rounded nose.

A "fictitious" train as also shown in Fig. 11 was built up smoothly in wood and tested against the actual train. With rounded nose and tail piece — $\frac{R}{V^2}$ was reduced to 0.570 giving a reduction of 72.2 per cent. Apparently a high degree of polish improved the resistance considerably.

Another important result of this investigation was the importance of cross-sectional cuts in the model. When in the model "fictitious" train length of 270 centimeters two "cuts" of 2 centimeters each were made the value of $\frac{R}{V^2}$ increased from 0.570 to 0.770 (see Fig. 11). Continuity of surface is seen to be highly important. Sauthoff voices a similar view.

Investigation of an English Ten-Coach Train

Sir Harold Hartley[2] reports some preliminary tests made in a wind tunnel at the National Physical Laboratory, on a 1/40 scale model of an L.M.S. train, comprising a "Royal Scot" locomotive, a tender, and ten coaches. It was found that

29 percent of wind resistance is accounted for by the engine and tender.
8½ per cent by first coach.
6½ per cent by each subsequent coach, or 52 per cent by all intermediate coaches.
9½ per cent by last coach.

The results also showed that at 60 miles an hour, without any head wind, approximately 400 horsepower is absorbed in overcoming the air resistance of such a train. This is said to amount to over 25 per cent of the power developed by the locomotive under these conditions. The air resistance at this speed is then $R = \frac{400 \times 375}{60} = 2{,}500$ lb. Estimating the projected

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* Professor in charge, Daniel Guggenheim School of Aeronautics, New York University, New York.

[1] Ch. Maurain, Resistance de l'Air Sur les Trains, Recherches et Invention, November, 1923.

[2] Research on the L. M. S. Railway, The Engineer, June 3, 1932.

area to be 97.5 sq. ft., the following approximate coefficients have been computed:

Part of train	Resistance at 60 m.p.h. in lb.	K on the basis of 97.5 sq. ft. projected area	Per cent of flat plate resistance
Whole train	2,500	.00720	220
Locomotive and tender	725	.00210	64
First coach	212	.00061	187
Intermediate coach	163	.00047	144
Last coach	236	.00068	20.8

Recent German Full Scale Experiments

In 1929 the German "Versuchsabteilung für Lokomotiven im Ausbesserungswerk Grunewald" undertook extensive tests which by extension of the usual methods allow the aerodynamic resistance to be more closely evaluated. These tests have been analyzed by Friedrich Sauthoff,[3] though first reported by Nocon.[4]

The measurements included: 1—Drawbar pull; 2—time.; 3—speeds relative to the track; 4—automatic records of the strength and direction of the relative wind. For these records a recording wind vane, and a Venturi tube connected to a recording pressure gauge were mounted well ahead and above the locomotive.

The true drawbar pull is determined from the equation:

Pt = Pr + Pg + Pa on a straight run at constant track speed where
Pt = total pull
Pr = true draw-bar pull, or train resistance
Pg = pull due to grade
Pa = pull due to acceleration.

For two tests at the same track speed and angle of incidence but different relative winds we can then write

$$R_1 = (A + B\ Vt_1) + K\ (\alpha \text{ constant})\ V^2r_1$$
$$R_2 = (A + B\ Vt_1) + K\ (\alpha \text{ constant})\ V^2r_2$$
$$\text{and } K\ (\alpha \text{ constant}) = \frac{R_1 - R_2}{V^2r_1 - V^2r_2}$$
$$\text{while } (A + B\ Vt_1) = R_1 - K\ (\alpha \text{ constant})\ V^2r_1$$
$$= R_1 - \frac{(R_1 - R_2)}{(V^2r_1 - V^2r_2)} V^2r_1$$

Again if Rr = (A + B Vt) = rolling resistance, has been determined at two track speeds,

We can write $Rr_1 = A + B\ Vt_1$, $Rr_2 = A + B\ Vt_2$

$$\text{and } B = \frac{Rr_1 - Rr_2}{Vt_1 - Vt_2}$$
$$\text{while } A = Rr_1 - B\ Vt_1$$
$$= Rr_1 - \left\{\frac{Rr_1 - Rr_2}{Vt_1 - Vt_1}\right\} Vt_1$$

Obvious methods are pursued in obtaining the acceleration, the mean track speed, the mean relative wind, and the mean incidence angle of the relative wind.

In analyzing results, the assumption is made that the resistance equation of the train is of the form

$$Pr = R = A + B\ Vt + K\ \alpha\ V^2r$$

Where $K\alpha$ = a function of the angle of incidence of the relative wind, α.
Vt = speed on the track
and Vr = speed of relative wind

If then two tests are made with the same track speed, and the same angle of incidence, α, but different relative velocities, then the equation becomes

$$R = (A + B\ Vt) + K\ (\alpha \text{ constant})\ V^2r$$

This is a sufficient outline of the technique employed. The main criticism of this technique is that the drawbar measurements do not give the resistance of the locomotive, and it is the overall resistance of a train including the locomotive which it is essential to determine.

Effect of Train Length on the Resistance Coefficient

The main interest for American readers of Sauthoff's pamphlet lies in his discussion of the effect of train length on the resistance coefficient, and in comparison

[3] Die Bewegungswiderstände der Eisenbahnwagen unter besonderer Berücksichtigung der neureren Versuche der Deutschen Reichsbahn, V.D.I. Verlag, Berlin, 1933.

[4] Nocon, Neue Versuche uber den Fahrwiderstand von Personen und D-Zugwagen Glazers Annalen, March, 1931.

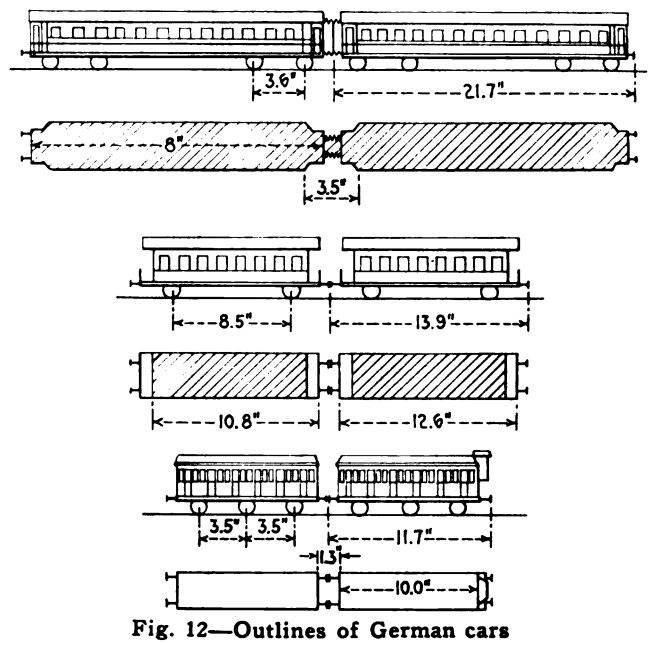


Fig. 12—Outlines of German cars

with tunnel values. He tabulates the equivalent area of (see Fig. 12) various trains (locomotive and tender excluded) as follows:

Train	Equivalent area F in sq. meters	K (on 120 sq. ft. projected area) = .00023 F.
6—car C4 ü	13.1	.00302
10—car C4 ü	19.3	.00445
12—car C4 ü	20.8	.00480
18—car C i	24.0	.00550
21—car C 3	27.7	.00636

From the tests of trains with different numbers of cars, and assuming that intermediate coaches all have the same resistance, Mr. Sauthoff concludes that for the C4 ü cars:

Intermediate car has F = 1.45 sq. meters K = .000345
Last car has F = 5.4 sq. meters K = .00123

The value of K = .000345 for an intermediate coach is in quite fair agreement with the value of .000397 given by the Berlin Technische Hochschule.

The extra resistance of the last car explains why the resistance of the entire train does not vary proportionately to the length. It is possible that owing to the experimental difficulties of the subject, Mr. Sauthoff gives too high a value to the resistance of the last train. His ratio, 3.82 of the resistance of the last coach to an intermediate coach is far higher than that obtained in the Berlin Technische Hochschule, or at the N.P.L. in tests of the L.M.S. train.

On the other hand Sauthoff is in general agreement with Professor Goss's early experiments.

Professor W. F. M. Goss published as early as 1898[5] experiments on a series of small similar models in a long tube (a crude species of tunnel, rather too small for correct results at speeds running up to 100 m.p.h.). While his quantitative values are open to question, the fact that he used a dynamometer whereby the resistance of each unit of his train could be individually determined makes his experiments interesting. All his models were substantially alike, and Sauthoff derives the following conclusions from an examination of Goss's data, regarding relative magnitudes: Single coach, 12; first coach (electric locomotive), 10; second coach, 0.8; any intermediate coach 1.0, and last coach, 2.6.

It will be remembered that the English experiments gave a ratio of 9½ per cent ÷ 6½ per cent = 1.45 for the resistance of the last coach when divided by the resistance of an intermediate coach.

[5] Electrical Review, Oct., 1898, and The Engineer, 1898, p. 164.

Another interesting derivative of Sauthoff's analysis is illustrated by the following table:

Train	Equivalent frontal area, sq. meters	Length, meters
12 C4 ü	20.8	261
18 C i	24.0	251
21 C3	27.7	246

The shortest train, but with the largest number of cars had the greatest resistance. Long coaches with the smallest number of openings for a given length should therefore give the lowest resistance.

Wind-Tunnel Tests of a Steam Locomotive

In the Canadian National Research Laboratories[6] tests have been made of a C.N.R. 6100 class locomotive and tender by the mirror method on a model of 1/12 scale. A number of systematic modifications were tried out which are reported together with drag measurements in Mr. Green's report. The research was conducted only partly with a view to reduction of air resistance, the main purpose being the improvement of the smoke flow. The following are only the most important selected results from a resistance point of view. The coefficient K is calculated on a projected area of 125 sq. ft. for the full size model:

1—Original unmodified model $K = .00268$; $\frac{R \times 100}{V^2}$ ft./sec. for model $= .1089$

2—Model with modifications 1-8 $K = .00154$; $\frac{R \times 100}{V^2}$ ft./sec. $= .0620$

3—Completely modified model $K = .00175$; $\frac{R \times 100}{V^2} = .0706$

The model with modifications 1-8 gave a very appreciable reduction in the air resistance, but was not considered satisfactory from a smoke point of view. Hence further modifications 9-27 were introduced with a resultant model which gave a somewhat higher resistance coefficient.

Wind-Tunnel Test of a Steam Locomotive in Presence of a Train

Maurain's experiments[7] contain interesting information on the interaction of a locomotive and tender and a following coach. These experiments were made on a 1/20 scale model of a French locomotive, a tender, a passenger car and a box car. The locomotive and tender were tested alone, and then in presence of the entire train. The resistance of the locomotive and tender was reduced 11 per cent by the presence of the train.

Davis's Formulae for Electric Locomotives and Trains[8]

W. J. Davis, Jr., as a result of analysis of a large number of road tests, gives the following formulæ as an appendix to his valuable paper. He includes truck area in his projected area:

	Values of A	K
Locomotives, 50 tons	105 sq. ft.	.0024
Locomotives, 70 tons	110 sq. ft.	.0024
Locomotives, 100 tons and over	120 sq. ft.	.0024
Passenger Cars, vestibuled	120 sq. ft. (leading)	.0024
	100-110 sq. ft. (trailing)	.00034
Multiple-Unit Cars:		
Motor cars, 2 trucks	80-100 sq. ft.	.0024
Motor cars, 1 truck	70-75 sq. ft.	.0024

Comparisons Possible

Even though all possible sources of information have been consulted, a great many gaps and uncertainties exist. Perfectly exact estimates of air resistance are not possible. With the use of judgment reasonable estimates and comparisons can be made.

[6] G. G. Green, The Wind Tunnel Development of a Proposed External Form for Steam Locomotives, Canadian Journal of Research, Vol. 8, January, 1933. See also the *Railway Mechanical Engineer* for May, 1933, page 149, and June, 1933, page 204.

[7] Recherches et Inventions, November 1, 1923. Resistance de l'Air Sur les Trains.

[8] loc. cit.

Comparison of Power for Single Cars

Comparing the coefficients for the parabolic-vestibule car of the St. Louis tests, the test of the conventional rail car, the rectangular box with rounded corners, and the Westinghouse Interurban electric car, we may say that Tietjens' value of K = .00127 is at least reasonable.

Again comparing the values of the streamlined interurban car, the test of the French Midi railway, and of the Jaray car, and inspecting the model of the streamline interurban car, we may say that Tietjens value is a trifle lower than would be realized in practice and assume .0003 as a very good practical value.

At 60 m.p.h. with a projected area of 83 sq. ft. we find

	K	Horsepower to overcome air resistance
Unstreamlined car	.00127	61
Streamlined car	.0003	14.3

The comparison is sufficiently striking.

Table I—Summary of Train Resistance Results

Model	Authority	K	Percentage of flat plate resistance
Single Cars			
Square flat plate	Eiffel	.00327	100
Conventional rail car, smooth sides	New York University School of Aeronautics	.00134	41.0
Jaray streamline car	New York University School of Aeronautics	.000591	18.1
Rectangular box, sharp corners and edges, with wheels	University of Michigan	.002200	67.5
Rectangular box, 9-in. radius corners and edges, with wheels	University of Michigan	.001180	36.2
Ordinary interurban electric car	Westinghouse	.00127	38.8
Perfectly streamlined interurban electric car	Westinghouse	.000204	6.25
Perfectly streamlined interurban electric car for two-way operation	Westinghouse	.000306	9.35
Interurban streamline car, front, rear and roof, but with windows and underparts of the present type	Westinghouse	.000460	14.1
French Midi (best car)	Issy-Les-Monlineaux	.000280	8.5
Short Trains			
Electric locomotive (ordinary)	Westinghouse	.00204	66.5
Electric locomotive (streamlined)	Westinghouse	.00090	26.8
Electric locomotive and one coach (ordinary)	Westinghouse	.00306	93.5
Electric locomotive and one coach (streamlined)	Westinghouse	.00128	39.0
Electric locomotive and two coaches (ordinary)	Westinghouse	.00408	125.0
Electric locomotive and two coaches (streamlined)	Westinghouse	.00164	50.0
German end coach (unstreamlined)	Berlin Technische Hochschule	.000560	17.2
German intermediate coach (unstreamlined)	Berlin Technische Hochschule	.000397	11.8
Union Pacific Train:	New York University		
Model No. 1, cabs No. 1 and 3		.000887	27.2
Model No. 1, cab No. 2		.000963	29.4
Model No. 2		.001038	31.7
Rheinisch-Westfallische Schnellbahn Two-car train with rounded head (lowest value)	Göttingen	.00100	30.6
Long Trains			
6-car C4 u (locomotive not included)	Sauthoff, analysis of full scale results	.00695	212
12-car C4 u (locomotive not included)	Sauthoff, analysis of full scale results	.01020	312
12-car C4 u (locomotive not included)	Sauthoff, analysis of full scale results	.01105	338
Intermediate coach C4 u	Sauthoff, analysis of full scale results	.000345	10.5
Intermediate coach Ci and C3	Sauthoff, analysis of full scale results	.000276	8.2
End coach C4 u	Sauthoff, analysis of full scale results	.00123	36.6
L.M.S. train, locomotive tender and ten coaches	N. P. L.	.00720	220
Locomotive and tender	N. P. L.	.00210	64
First coach	N. P. L.	.00061	18.7
Intermediate coach	N. P. L.	.00047	14.4
Last coach	N. P. L.	.00068	20.8
Locomotives			
C. N. R. locomotive and tender (unmodified)	Canadian National Research Council	.00268	87.5
With modifications 1-8	Canadian National Research Council	.00154	47.0
With modifications 1-27	Canadian National Research Council	.00175	53.5

Comparisons of Power for Trains

The following calculations have been made on a uniform projected area of 125 sq. ft. for air horsepower required at 100 m.p.h. No considerations are offered as regard rolling resistance, passenger accommodation, etc.

Table II—Comparison of Power for Passenger Trains Based on Same Cross-Sectional Area

$A = 125$ sq. ft. Speed $V = 100$ m.p.h. $R = K A V^2$ $P = \frac{R V^3}{375}$

Train	Formulae employed	Air resistance in lb.	Hp. required for air resistance
1—Union Pacific train: power car and 2 passenger cars, Model No. 1, Cab No. 1	$K = .000887$	1110	296
2—Electric locomotive and two passenger cars (unstreamlined)	$K = .00408$	5100	1360
3—Electric locomotive and two passenger cars (streamlined)	$K = .00164$	2050	545
4—L.M.S. train, locomotive tender and ten coaches....	$K = .00720$ cross-sectional area increased to conform to American practice	9000	2400
5—Steam locomotive, six coaches	a. $K = .0024+6(.0034) = .004444$. (Davis's formula)	5550	1490
	b. $K = .00302+.0024 = .0542$. (German data)	6770	1810
	c. $K = .00507$ L.M.S. figures $= .00210 + .00061 + 4(.00047) + .00068$	6590	1755
6—Electric locomotive and six coaches	$K = .00805$	10,060	2690
7—French trains: a—Locomotive, tender, coach and box car.....	Maurain's estimates..	....	980
b—Locomotive, tender, 10 coaches and box car.	Maurain's estimates..	....	2440

Railroad men will be able to make such calculations for themselves far better than the writer of this article. The results are summarized in Table II, to which the following comments apply:

Line 1—The value of K is taken directly from tunnel test without correction.

Lines 2 and 3—The Westinghouse tunnel results for the streamlined train are taken without correction.

Line 4—The assumption has been made that only a correction for cross-sectional area need be applied. This is not strictly correct; the resistance of an American train would be somewhat greater owing to its greater length and skin friction.

Line 5—A number of calculations based on different assumptions have been made here. The first calculation has been made on Davis's formulæ where $K = .0024$ for the locomotive and .00034 for coaches. The value of K for the locomotive given by Davis is less than that determined from the Ottawa tests, but the C.N.R. locomotive was not faired in by a trailing car. The second calculation has been made on the basis of the German six-car C4ü train, with an addition of .0024 for the locomotive. The third calculation has been made by taking the coefficients of the L.M.S. train for the ten-coach train and applying them to a six coach train.

Line 6—The Westinghouse tests were made on an electric locomotive and two coaches. By linear extrapolation to a six-coach train, Dr. Tietjens arrived at a value of $K = .00805$. Tietjens' coefficient for the electric locomotive is a trifle below Davis's figure but his value for a coach of .00102 is nearly three times as high. It would seem that extrapolation is dangerous, until a fair number of coaches have been included.

Line 7—Maurain's estimates are based on a tunnel test of a locomotive, tender, coach and box car, with extrapolation to ten coaches for French construction and are reproduced without correction.

Conclusions

In view of the fact that tests have been in different tunnels and by different methods, *all the above comparisons and calculations should only be regarded as approximate.* The following conclusions may be drawn however:

1—The ordinary steam locomotive and tender is highly wasteful from the point of air resistance, more so than the electric locomotive.

2—The air resistance of an ordinary steam locomotive can be appreciably reduced by fairing without any basic change in its design.

3—The first coach of a steam train is badly affected by the low height of the tender preceding it.

4—Extrapolation from tests of very short trains to long trains is unjustified, because the resistance of intermediate coaches in a long train is relatively so low.

5—Considerable improvement may be expected by such modification of conventional train equipment as: addition of a nose piece; addition of a tailpiece; covering in of tender; "smoothing out" of sides of train; care in design of intercommunicating corridors. Sum total of such changes may be surprisingly effective.

6—Rounding of corners is helpful.

7—Truck and wheel resistance is an appreciable proportion of the entire resistance of a coach.

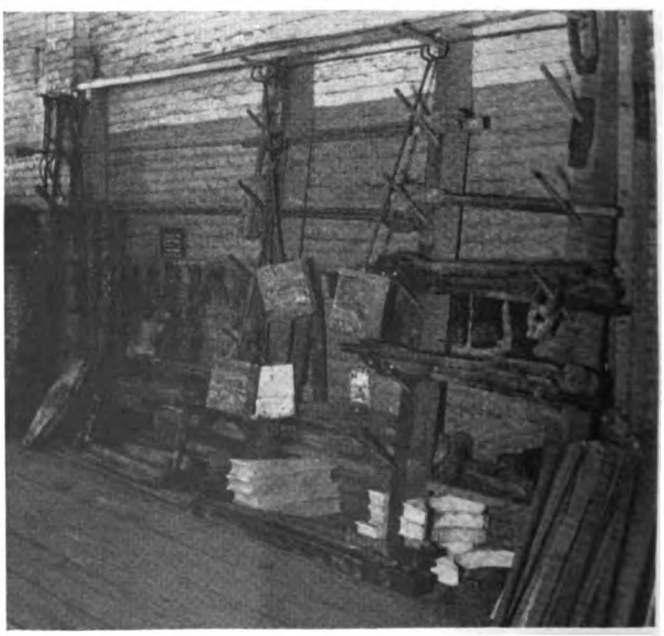
8—Modern equipment such as the Union Pacific Train should have only a fraction of the resistance of even a short conventional train.

9—Exact computations of air resistance for steam trains are impossible on present data.

10—Rail cars, trolley cars and very short electric cars may have their resistance reduced appreciably by very simple methods.

A study of the effect of side winds has been made and the general conclusion is that a streamlined train will, even in side winds, show aerodynamic superiority over the conventional train. Some reservations have to accompany this statement in the present state of our knowledge. The effect of side winds will be adequately discussed in an article to be published at a later date.

* * *



Convenient storage rack which helps to keep material off the floor in the car shop—Illustration shows bottom rods, turnbuckles, levers, reservoir blocks and bands, hand-brake chains, etc.—A shelf is provided on the wall at the left for dope buckets and oil cans

All-Welded Light-Weight C. M. St. P. & P. Coach

Interesting design of welded construction effects marked weight reduction — Unusual provision made for passenger comfort

THE Chicago, Milwaukee, St. Paul & Pacific now has constructed at its Milwaukee shops the first six units of an order of 52 streamlined, light-weight, all-welded steel coaches which are a distinct departure from ordinary car-building practice and which provide comforts, and indeed luxuries, not ordinarily available in coach equipment. With a saving of about 35 per cent in weight over conventional coaches of the same size, the new cars are designed to effect substantial economies in operating cost and also to facilitate maintaining higher train speeds.

All-Welded Body Construction

The new coach, No. 4400, is of conventional size, being 10 ft. wide by 13 ft. high above the rails and 72 ft. 6 in. long over the body end posts, or 80 ft. 8 in. long over the pulling faces of the couplers. It weighs about 96,000 lb. and has a total seating capacity of 54, including 40 in the main compartment, five in the ladies' lounge room and nine in the men's smoking room. This may be compared with a total weight of 146,000 lb. and a total seating capacity of 78 in conventional Milwaukee coaches of the same size, embodying riveted steel construction.

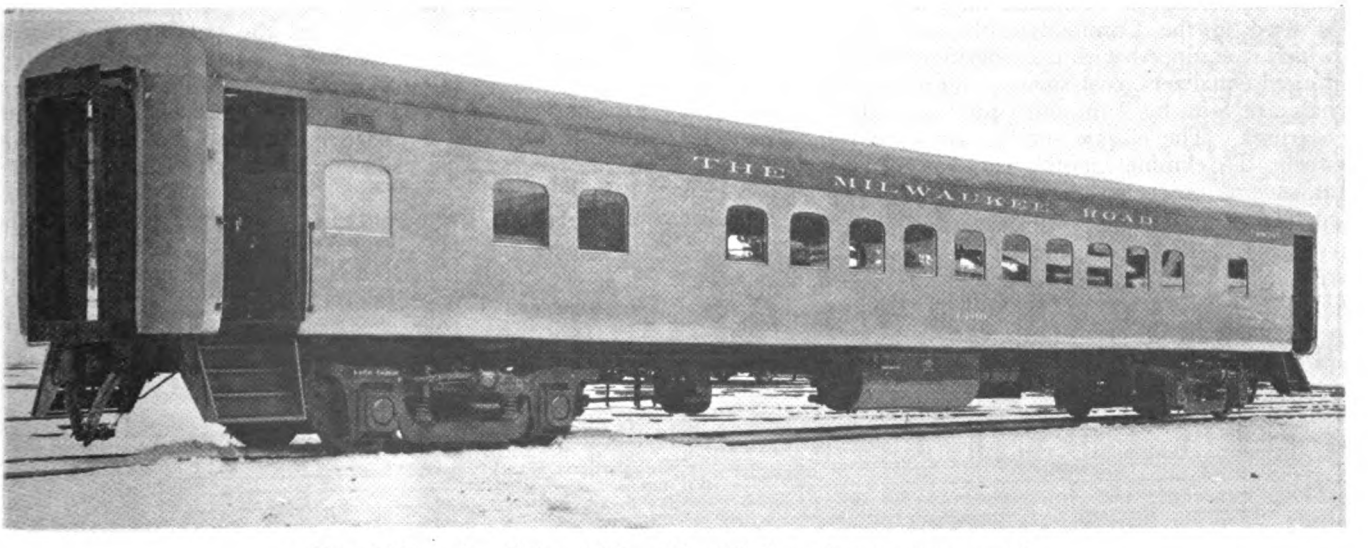
The new car is tubular in shape and streamlined to the extent that it has a turtle-back roof, side sheets rounded inwardly below the windows and no projections on roof or sides such as ventilators, window sills, belt rail, etc. The entire body of the car is fabricated by electric welding and without the use of rivets. The underframe, including the center sill, bolsters, buffer beams and body end sills, is a built-up design, consisting of structural shapes, plates and sheets joined by welding. The floor pans are made of ⅛-in. sheets, formed with the flanges extending from side sill to side sill. These pressed pans are joined to each other and to the car frame by continuous and, in some places, staggered welds, the latter overlapping. The top floor is made of 1¼-in., 5-ply, pine veneer secured to the pan flanges by Parker-Kalon self-tapping screws. The body and vestibule end frame construction is built up of steel shapes, pressings and sheets, also joined by welding. The side sills consist of 4-in., 8.2-lb. Z-sections, extending from body corner post to body corner post. Subsequent cars will include Commonwealth one-piece cast steel bolsters and platforms.

The side pans, all of ⅛-in. steel sheets, are of three different sizes, the first extending between the windows from the side sill to the side plate and made with channel-shaped flanges. The second pan extends from each window down to the side sill, the top flange of the pan forming the window sill. The third pan extends from the top of the window to the side plate, with angle-shaped flanges on four sides. The pressings are made with open corners and have holes punched in the flanges for the purpose of firmly bolting them together and squaring the entire superstructure before welding is started. After the superstructure is welded, which includes closing up all the open corners, the bolts are removed. All flanges are continuously welded both inside and out. The window frames, oval at the top and square at the bottom, are of No. 12 gage steel, pressed to a U-shaped contour, with inwardly projecting flanges to suit the window construction.

The turtle-back roof is formed of $\frac{3}{16}$-in. pressed side plates and $\frac{1}{16}$-in. roof sheets which are pressed-steel pans flanged on all sides, with open corners subsequently filled in when the flanges are welded. The ridge pole comprises ⅛-in. by 3-in. steel strips welded between the center-pan flanges.

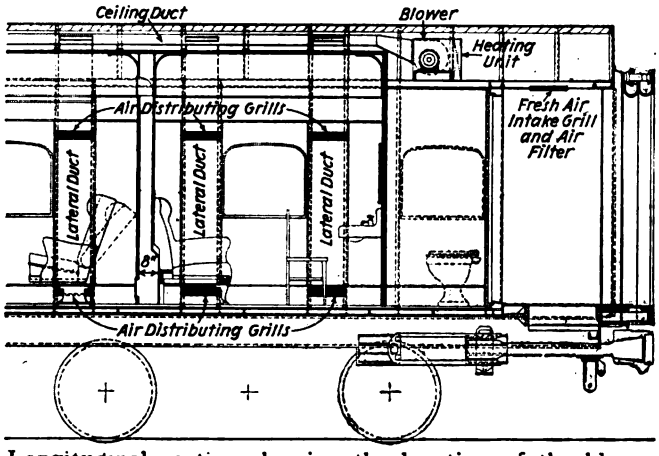
Aluminum-Foil Insulation

The car is completely insulated with a new type of



New Milwaukee light-weight, all-welded steel passenger coach

aluminum-foil insulation notable for light-weight and low heat conductivity. This material, known as Reynolds' Metallation is furnished by the Reynolds Metal Company and consists of thin aluminum foil, of about .0005 in. gage, firmly cemented to one or both sides of a tough, heavy craft paper and applied in a series of layers with ½-in. to ¾-in. air spaces between the respective layers. Insulation pads, comprising three double layers and two single layers of this material, are held in fabricated frames made from wood or other



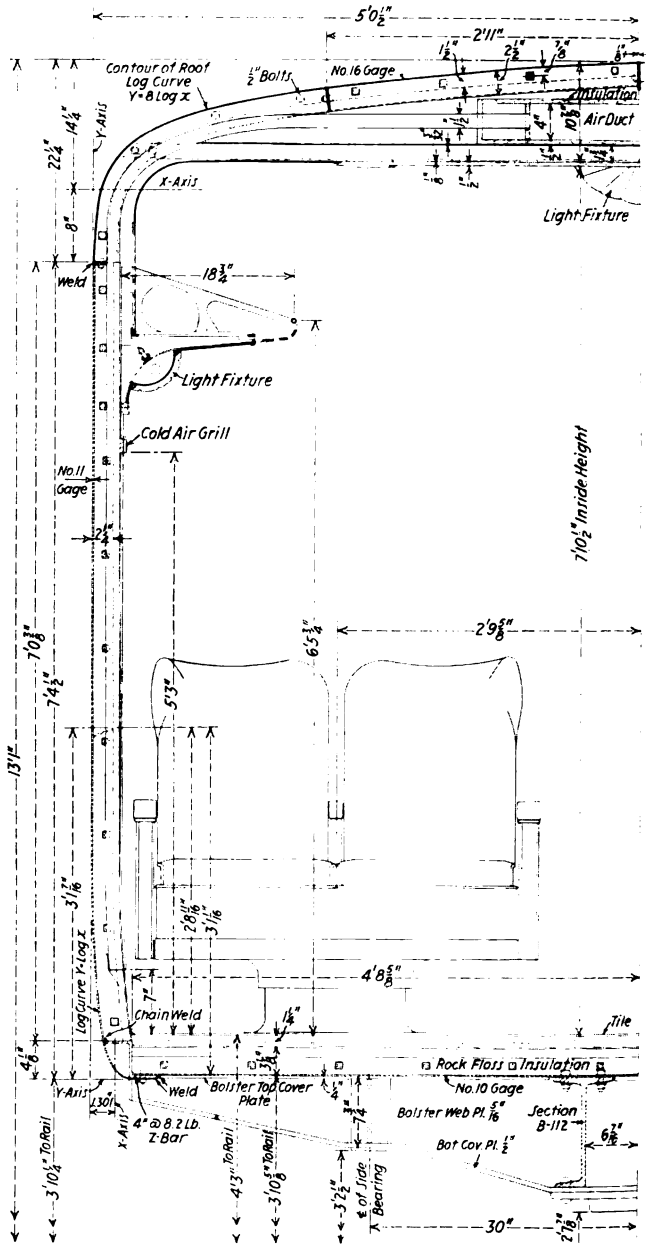
Longitudinal section showing the location of the blower fan and the air-distributing ducts

material, which fit in the floor and side pans. At curved sections in the car body, such as the lower side and the roof, K-B board, or flexible linoleum, is fitted in the curved pans, and the paper-backed aluminum foil held in place against the linoleum by Gagnier metal clips, such as are used in the automotive industry for applying panels of interior finish.

A further adaptation of automotive practice is followed in the application of Insulmat, a sound-deadening material which is sprayed to a thickness of about ⅛ in. on all interior wall metal surfaces to dampen vibration and reduce the transmission of external noises to the interior of the car. A single layer of craft paper with aluminum foil on one side is then applied directly on this sound-deadening material.

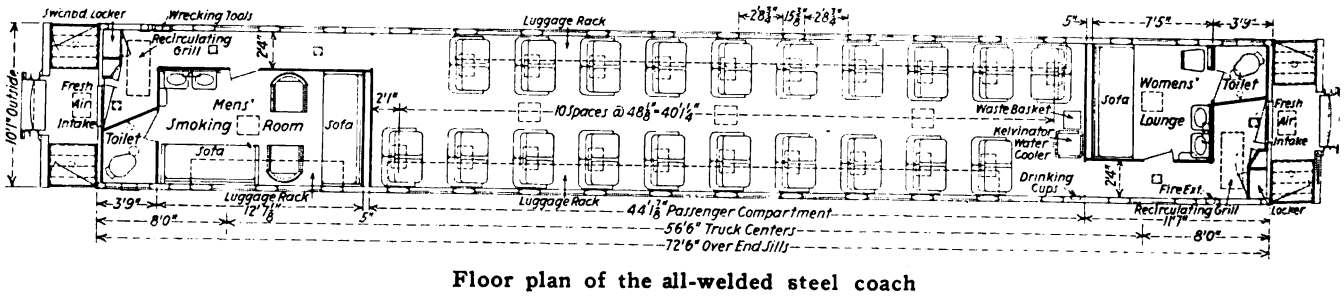
The Trucks

The four-wheel truck design was developed with a view of obtaining minimum weight consistent with the required strength. A special high-tensile cast-steel alloy is used in the Commonwealth one-piece truck frame which is equipped with a swing-motion bolster, the usual forged equalizers, cast-steel spring plank, etc. The journals are 5-in. by 9 in. and equipped with Timken roller bearings. The elliptic springs are of chrome-vanadium steel. To eliminate noise, rubber inserts are employed at several points in the truck construction to prevent metal parts subject to vibration from coming in direct



Half cross-section of Milwaukee all-welded coach

contact. Ease of truck swiveling is assured by the use of a ⅛-in. manganese steel plate and a ¼-in. Oilite plate applied between the body and the truck center plates. All brake rigging and connected parts are applied directly to the truck which is equipped with American Steel Foundries Simplex unit-cylinder-type clasp brakes, with one 8-in. by 7-in. brake cylinder mounted on each side of the truck frame. One of the trucks is also equipped with the Dayton-Roderwald combined V-belt and universal type axle-generator drive. The truck with the



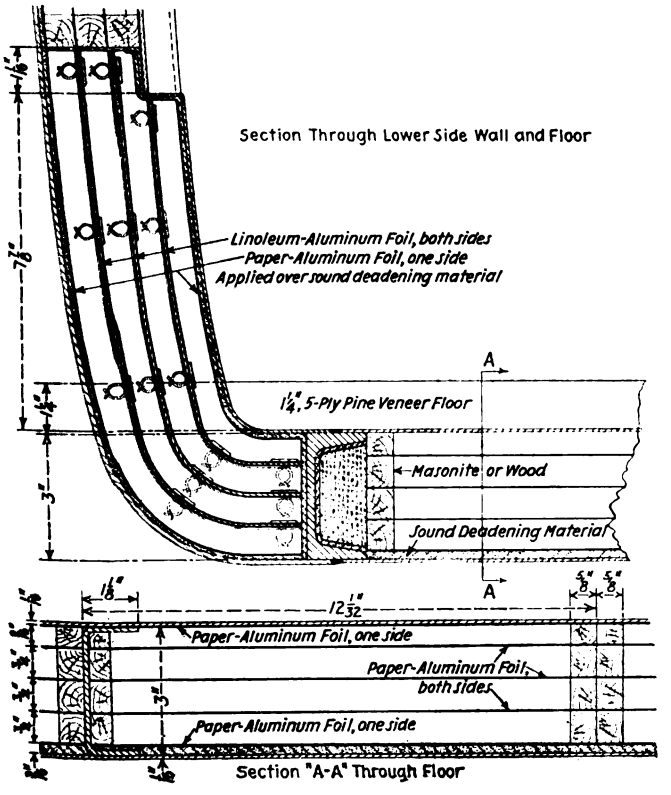
Floor plan of the all-welded steel coach

generator drive weighs 15,310 lb. and the plain truck, 14,560 lb.

Heating, Ventilation and Lighting

The car is heated and ventilated by means of a system of concealed air ducts, steam pipes, motors and blowers, the system being designed with a view of ultimately applying air-conditioning apparatus. A Sirocco blower unit rated at 1,000 cu. ft. per min. is located under the roof in each end of the car, forcing air through the Vapor copper-tube and fin-type heating and cooling unit, as the case may be, and into a central ceiling duct, from which it is distributed into lateral ducts located behind the pilasters at each seat and finally into the car through Uni-Flow grilles. There are two grilles in each pilaster and, during the winter season, the top grille is closed by means of a damper, thus forcing the hot air to pass to the lower grille at each seat base near the car floor. For summer cooling the damper in the upper grille is opened, thus automatically blocking the passage to the lower grille and permitting the cool air to pass into the upper section of the car.

The blowers are of the double-intake type, fresh air being drawn through an air filter and grille located in the ceiling of the vestibule, with a suitable damper arrangement provided to control the proportion of fresh air admitted. Recirculated air is drawn through a second grille in the ceiling of the hall adjacent to the end door. Temperatures in the car are kept within desired limits



Sections showing the application of aluminum insulation at lower side wall and floor

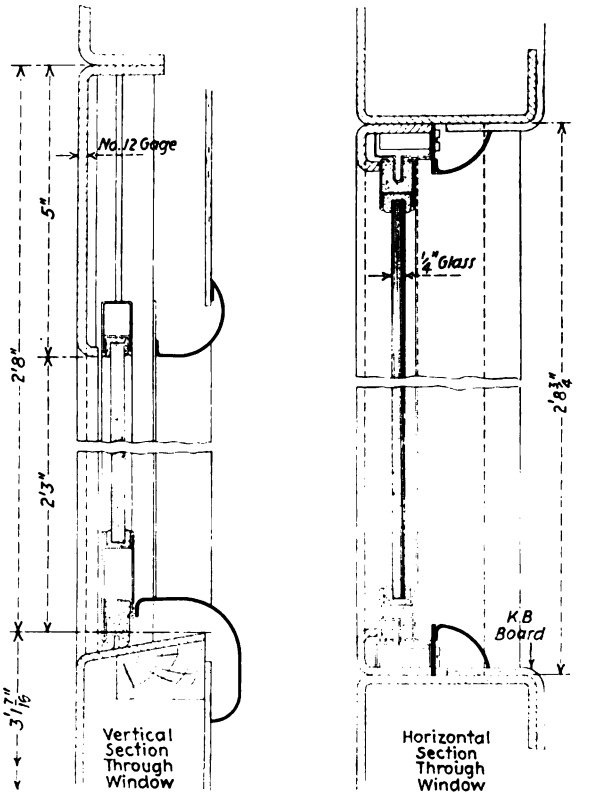
by means of Vapor thermostat control equipment. For emergency or yard heating, heating coils are provided in the partitions between the main body of the car and the lounge rooms, these coils being of sufficient size to heat the air in the car to around 50 or 60 deg. in sub-zero weather.

Electric power for the 32-volt lighting system in the car is provided by means of a Safety 5-kw. generator driven by a Dayton-Roderwald V-belt unit mounted on one of the trucks. This generator furnishes power for the lights and for charging an Exide Ironclad 450-amp.-hr. storage battery, as well as supplying power for blower motors, water cooler, etc.

The lighting system is designed to give a light intensity at the reading level of about 8 foot-candles. The ceiling lights are supplemented by individual bracket lights under the luggage rack adjacent to each seat which gives a uniform distribution and avoids shadows. All lighting fixtures are of a unique and attractive design in aluminum.

Interior Finish and Conveniences

Unusual attention has been given to the interior finish, the layout and the provision of exceptional comforts. A glance at the floor plan shows the ample size of the men's



Sections through the windows

smoking room and the women's lounge. Seats in the main room are of the high-back, double-rotating, adjustable, reclining type spaced 48½ in. on centers, with the center line of the base opposite the panel section between the windows. Windows are of ¼-in. polished plate glass, frameless and moved up and down in felt-covered rubber guides by Briggs & Stratton regulators. Overhead baggage racks are continuous and spacious. The interior finish is composed of removable cloth-covered panels; the floors are of Durite asphalt tile in colors, harmonizing with the upholstery and tapestry color effects of the interior finish. The ceiling is of five-ply poplar veneer, flat at the center with curved sides and ends. The general color scheme is a light flesh colored ceiling, brown side walls and green floors, with aluminum trimmings and lighting fixtures.

Another provision for the comfort of passengers is the installation of a Kelvinator electric water-cooling cabinet especially designed for railroad service. Dixie individual paper cups are provided.

Tractive Force of Steam Locomotives

By A. I. Lipetz*

Discussion of the Comments Made by H. S. Vincent to an A.S.M.E. Paper by A.I. Lipetz on the Ratios of Modern Locomotives

AT the annual meeting of the American Society of Mechanical Engineers, December 5 to 9, 1932, I presented a paper on "Horsepower and Tractive Effort of Steam Locomotives (Locomotive Ratios)" which was published in the Railroad Section of the Transactions of the Society for July 30, 1933, under RR-55-2. The Transactions also contained the remarks of 16 discussors (pages 16-32) and the author's closure (pages 32-42).

H. S. Vincent participated in the discussion and presented valuable and original remarks pertaining to a method of figuring tractive efforts developed by him. To this an essential part of my closure was devoted. An abstract of the paper and discussions were published in the *Railway Mechanical Engineer* (March, April and October, 1933, issues). The discussions and author's closure, however, as they were published in the *Railway Mechanical Engineer,* did not contain either Vincent's remarks or my reply to them for the reason that a separate article, entitled "Ratios of Modern Locomotives," was published by H. S. Vincent in the November and December, 1933, issues of the *Railway Mechanical Engineer*. Consequently, the editor allotted me some space for a reply, of which I am now availing myself.

In substance, Vincent's later remarks do not differ from those made during the discussion of my paper in the American Society of Mechanical Engineers as printed in the Transactions of the Society. My reply which followed his discussion was not taken by him into account in many cases. To attempt to reply to all points raised by Mr. Vincent in his article, I would have to repeat some of the remarks made in my closure. This would involve fruitless debate on immaterial details. Moreover, my paper is to be followed by another which I expect to present before the coming annual meeting of the A.S.M.E. next December. I shall, therefore, leave the less important details of Vincent's reply to my next paper, while at present I want to reply to those points which, in my opinion, form the essential disagreement between Mr. Vincent and myself.

Cole's method permits to evaluate the tractive force of a locomotive on the basis of cylinder sizes, while the method suggested by me does the same thing on the basis of boiler evaporation. In either case certain constants are used, called "speed factors" in Cole's method, and "moduli" in my method. Vincent, on the other hand, prefers a formula, which is an empirical one containing both cylinder sizes and boiler evaporation.

On the basis of six locomotives, of which five were long cut-off locomotives and one a limited cut-off locomotive, I showed that the tractive force can be simply represented by the boiler evaporation and certain moduli. Vincent, using five examples of locomotives, of which three are limited cut-off and two are long cut-off locomotives, tends to show that my moduli do not agree with test figures. He also shows that for two long cut-off locomotives tested at the Altoona testing plant his formula is in agreement with test results, but it follows from his curves that my moduli give equally good agreement with tests for these two cases. The fact, however, that the tractive force of one limited cut-off locomotive, namely, the Boston & Albany A-1, can be well represented by my moduli, is set aside with the questioning of the validity of that particular test. The fact of the agreement in the case of the A-1 locomotive will be explained later. Further, Vincent does not give any explanation of the fact that, as shown in my discussion (page 34), his formula gives exaggerated results when compared with road test figures.

It is true that my method has been based on road test figures. It is further true that Vincent's formula corresponds better than my moduli when compared with some testing plant results. Furthermore, it is also true that my figures have been based mainly, except in one case, on data obtained from testing long cut-off locomotives, while the Vincent formula is based on test data from both long and limited cut-off locomotives. However, all this has nothing to do with the main difference between the two methods, which lies in the fact that his formula gives too high values for ordinary every-day running conditions. They agree with test data (either road, or stationary, more often with stationary) when the boiler happens to be forced to what is near the limit, but not under average conditions. This is evident from curves given in my closure to the A.S.M.E. paper (page 34), where actual performance curves are compared with those according to Vincent's formula, and even from some of the curves given in Vincent's article, for instance, Fig. 8[1] (Texas & Pacific G-1b), Fig. 11[2] (Texas & Pacific I-1), Fig. 12[2] (three-cylinder Missouri Pacific), where a great discrepancy can be seen between his curves and actual test points.

Cylinder Volume

There is no doubt that any locomotive can develop, within certain limits, higher and lower tractive forces, depending upon the rate of firing the boiler. A locomotive with large cylinders can develop a larger tractive force, if at low speeds the locomotive boiler is forced at these speeds. This can be done the easier at low speeds, as the total power, and consequently, the steam demand on the boiler, is then usually low. It is immaterial whether the locomotive is of the limited cut-off or of the long cut-off type. The large tractive force is only a result of the large size of cylinders and boiler firing.

Mr. Vincent was very close to the proper explanation of this fact when he made up his Table I, Design Ratios.[3] He gave in the last column the ratios of evaporative heating surface in square feet to the volume of two cylinders in cubic feet. He stated that this ratio,

* Consulting engineer, American Locomotive Co., Schenectady, N. Y. Non-Resident Professor, Purdue University, Lafayette, Ind.

[1] *Railway Mechanical Engineer*, November, 1933, page 394.
[2] *Railway Mechanical Engineer*, December, 1933, pages 430, 431.
[3] *Railway Mechanical Engineer*, November, 1933, page 390.

according to a recommendation of the American Railway Master Mechanics' Association made in 1897, was to be 200, and that for modern locomotives it varies from 217.5 to 247.5.

This ratio is very important, and in order to be more significant, it should also include boiler pressure. It is evident that two locomotives identical in all parts, one having a boiler pressure of 200 and the other a boiler pressure of 300 lb. per sq. in., can not have identical cylinders, even if both locomotives have the same, either long, or limited, cut-off. The cylinders for higher boiler pressure must, of course, be proportionately smaller, and, therefore, boiler pressure must be taken into account when cylinder sizes are being considered. In accompanying Table I, column 2, all locomotives used by Vincent in his article and by me in my paper are shown. Other data are given in the next columns: In column 3—heating surfaces in square feet (H_e); in column 4—boiler pressures in pounds per square inch (p_b); in column 5—volumes of all single-expansion cylinders in cubic feet (U), and in column 6—the ratio of figures of column 3 to the product of the figures of columns 4 and 5, in other words, the heating surface referred to the boiler pressure and cylinder volume, or $m = \frac{H_e}{p_b U}$

Table I

1	2	3 H_e sq. ft.	4 p_b lb. per sq. in.	5 U cyl. vol. cu. ft.	6 $\frac{H_e}{m=p_bU}$
I	New York Central J-1	4484	225	15.90	1.253
	Pennsylvania E6s	2688	205	11.44	1.146
	Lehigh Valley 5100	5422	250	19.88	1.091
	Lehigh Valley 5200	5441	255	19.66	1.085
	Pennsylvania K4s	4035	205	18.56	1.061
	Timken 1111	5111	250	19.88	1.028
	New York Central L-2	4449	225	19.88	.995
	Boston & Albany A-1	5110	240	21.40	.995
II	Missouri Pacific 3-cyl.	3786	200	22.03	.859
	Texas & Pacific I-1	5113	250	24.46	.836
	Texas & Pacific G-1b	3811	200	22.81	.835
	A., T. & S. F. 5000	6135	300	27.82	.735
	Pennsylvania Ils	4774	250	27.06	.706

It is interesting to note that notwithstanding the wide variation in columns 3, 4 and 5, column 6 is more steady, both for group I, which includes all long cut-off locomotives and the B. & A. A-1, which is a limited cut-off locomotive, and for group II, which includes limited cut-off locomotives as well as the Mo. Pac. three-cylinder and the T. & P. G-1b, long cut-off locomotives.

The common feature for locomotives of group I is that my moduli do agree with test results for these locomotives, whether long cut-off or limited cut-off locomotive, while the common feature for the locomotives of group II is that my moduli do not agree, irrespective of whether they are of the limited or long cut-off type. At the same time the common feature of the first group of locomotives is that the ratio *m* is above .995, or, roughly speaking, 1.0, while this ratio for the second group of locomotives is below .859, or, say, .86, there being a wide gap between the coefficient *m* of these two groups.

The fact that the coefficient *m* for the first group is 1.0 or more, and for the second group it is .86 or less, simply means that the cylinders of the first group are normal while the cylinders of the second group are excessive, and Vincent's criticisms of my moduli are thus reduced to the fact that my moduli do apply to locomotives with ratio *m* of .995, approximately 1.0, and more, while they do not apply to locomotives with *m* equal to .86 or less, in other words, to locomotives with over-sized cylinders.

The above also explains why the test results of the B. & A. A-1 locomotive (*m* = .995), although of the limited cut-off type, are in agreement with my moduli and, therefore, it is not surprising at all to see that this locomotive gives results in accordance with my moduli; there is no necessity for questioning the test report.

"Tractive Force" Needs Explanation

As explained in my paper and in the author's closure, the term "indicated tractive force" becomes a definite conception only when the conditions at which the tractive force is produced are specified, as for instance, the *maximum* tractive force, the *most economical* tractive force, the *constant evaporation* tractive force, or constant *coal rate* tractive force. (Transactions RR-55-2 of the A.S.M.E., page 40). If we were concerned with the maximum tractive force, this conception would be definite, and this is what the majority of the Altoona test results is giving. Vincent is not trying to produce the maximum tractive force because he states that "this (maximum) is always greater than the normal tractive force," which is "in accordance with the best known practice for its type and in which the fuel consumption and evaporation reaches but does not exceed a predetermined limit.[4] This is exactly what I call in my paper "performance tractive force," and which is represented by my moduli. According to Vincent, it is less than the maximum tractive force and, therefore, there should be no surprise that my curves are lower than the Altoona test curves. Professor Lomonossoff made extensive and accurate tests, among others, with 0-10-0 locomotives, both on the road and on a stationary testing plant, and found that the former gave in some cases up to 23 per cent lower results than the latter, the locomotives in both cases being identical in all essential details.[5]

Neither of the foregoing clearly defined tractive forces should actually be considered in our problem because during operation the locomotive is burning no constant amount of coal per unit of grate area per hour; nor is it generating a constant amount of steam per unit of heating surface per hour; nor does it work at constant efficiency, or any other condition to which we might wish to limit ourselves for the simplicity of our analysis. The fact is that the operation of the locomotive is being conducted so as not to exceed certain excessive straining which would cause damage to the tubes, clinkering, drop in superheat or pressure, etc. It consists mainly of this best known practice, according to Mr. Vincent, of operation of a locomotive, about which an experienced engine driver knows how, but probably would not be able to explain why, and which ultimately results in a more economical operation as regards fuel, maintenance, etc. It is always possible to force the boiler and get more power from the locomotive up to a certain limit, and there is no doubt that it is, therefore, possible during tests to get tractive forces that are higher than obtained, from regular service runs, called performance curves. My study of these problems showed that these curves are better understood from the point of view of overall locomotive efficiency. I have chosen the Pennsylvania Ils locomotive No. 4358 for this analysis for the reason that the discrepancy between my moduli and the Vincent formula is more pronounced in this locomotive than in other any other of those referred to by Mr. Vincent. The Ils is the best example of an over-cylindered locomotive, *m* being only .706, the lowest in Table I.

Overall Efficiency an Important Factor

Fig. 1 shows tractive-force curves of the locomotive. The Vincent curve is shown in a dash-and-three-dot

[4] *Railway Mechanical Engineer*, November, 1933, Page 391.
[5] 0-10-0 Locomotives E, Esh, Es, by G. Lomonossoff, Berlin, 1924 (in Russian), page 201.

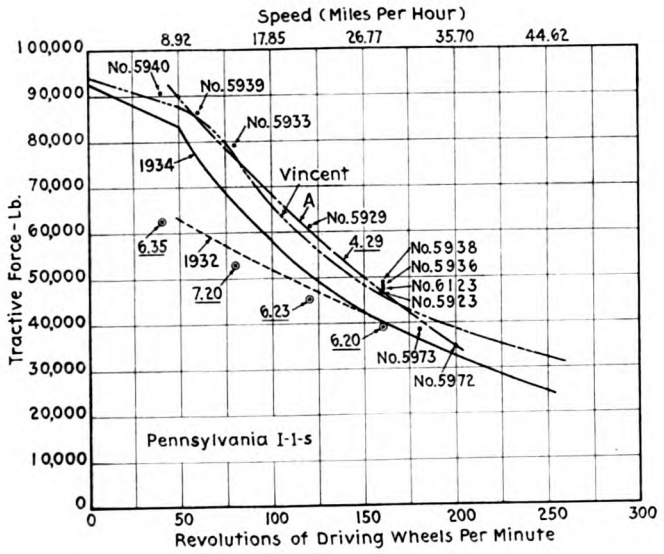
line.[6] The maximum test figures are shown by points with numbers corresponding to test numbers given in Pennsylvania Railroad Bulletin No. 32. A dash-and-one-dot line (curve A) is the one that approximates the test figures best. It is really very close to the Vincent curve. In Fig. 3 of his article Vincent marked also points from another I1s locomotive (No. 790) which I omitted in the present chart because this locomotive has a different boiler, a type A (instead of E) superheater, and has no feedwater heater.

In my closure to the discussion of the paper I enumerated in Table 19 (page 36) the main data of these high tests. They are partly repeated in Table II herewith, which includes all the high points of curve A.

Table II

Test number	Boiler efficiency, per cent	Overall locomotive efficiency, per cent
5940	56	4.7
5939	55	5.1
5933	54	5.6
5929	42	4.0
5938	41	3.6
5936	39	3.8
6123	36	4.1
5923	45	4.5
5972	49	4.4
5973	35	3.1
Average	45.2	4.29

This shows that the overall efficiency fluctuated between 3.1 and 5.6 per cent. The average of these overall



Revised tractive force curve

efficiencies is 4.29, marked on curve A. The average boiler efficiency for the maximum tests was only 45.2 per cent. In other words, the boiler and the locomotive were highly stressed, and then they gave a tractive-force curve that coincided with the Vincent formula.

All other test figures given in the test report are below this and the Vincent curve. The averages of the tractive forces of all tests for each of the speeds at which the locomotive was tested (40, 80, 120 and 160 r.p.m.) are marked on the chart by points in circles. The averages of corresponding efficiencies are shown by underlined figures. They vary between 6.20 and 7.20 per cent. It is interesting to note that the points which correspond to the averages, shown on the chart by points in circles, come very close to the curve on the basis of my moduli (1932); in other words, while it may be true that it is possible to get for this locomotive as large a tractive force as represented by Vincent's formula, the overall efficiency of such a locomotive performance would be only 4.29 per cent, whereas, if the operation is performed in accordance with the 1932 curve, the efficiency of such a performance would be about 6 per cent.

This is true with respect to the performance of other locomotives in accordance with my moduli, which means that they correspond to a reasonable, economical utilization of a locomotive, although it may be also true that tractive force of 10 to 15 per cent more can be obtained, if the operator is satisfied with a much lower overall efficiency. He will gain some in tractive force, but lose much in economy.

Revised Curves for Large-Sized Cylinders

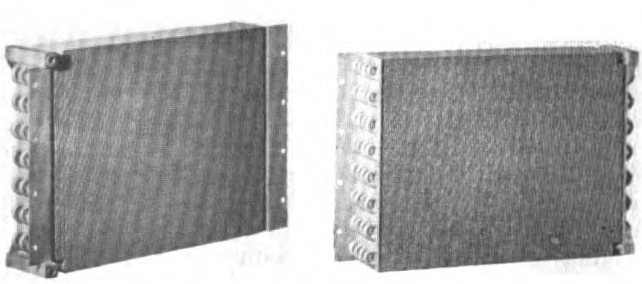
I must concede, though, that for locomotives with large-size cylinders it may be necessary to force the boiler at low speeds in order to approximate the starting or adhesion tractive force. I have, therefore, devised a new method for locomotives with ratio m less than 1.0. By this method it is possible to modify the shape of the curve between 50 and 150 r.p.m. as shown approximately on the chart in full line marked 1934. The manner of plotting this curve, depending upon the above mentioned coefficient m, will be expounded in the coming paper before the A.S.M.E., next December. This curve comes up closer to the maximum test figures for low speeds than the 1932 curve, corresponding to a lower overall efficiency, probably of 5 per cent, and following later the 1932 curve with about 6 per cent overall efficiency. The essential difference between the 1932-1934 curves and the Vincent curve lies in the difference of the just mentioned overall efficiencies (6, 5 and 4 per cent, approximately).

[6] Copied from Fig. 3 of Vincent's article, *Railway Mechanical Engineer* November, 1933, page 391.

Heat Transfer Surfaces For Air Conditioning

THE Young Radiator Company, Racine, Wis., after having had a broad experience in the development of heat-transfer surfaces for commercial and other purposes, has recently assisted leading manufacturers of rail equipment in the development of suitable heat transfer surfaces for air-conditioning apparatus. Special evaporators and condensers of sturdy construction, built to withstand rail vibration—the severest kind of service—have been improved to a high degree.

The accompanying illustration shows two views of a Young condenser. The tubes and fins are fusion bonded, made integral for strength and to provide the best possible heat conduction. The entire surface is copper, but, for special installations where weight is a governing factor, aluminum cores have been developed and are working satisfactorily.



Young 4-row fusion bonded fin condenser coil—Connections adapted for Freon

EDITORIALS

A Trend in Locomotive Development

It is probable that the German State Railways have had more experience in the operation of steam locomotives which depart radically from the time-honored type both as to boiler construction and in the method of converting the energy in the steam into useful mechanical work than have the railways in any other country. This experience has included turbine locomotives, high-pressure locomotives, and locomotives burning pulverized coal. Excepting the pulverized-coal locomotive, which included the conventional boiler, these developments all concentrated on improving the thermal efficiency. Parallel with these experimental developments has been a sustained development of standard locomotives of conventional type with a view to producing a locomotive of good operating characteristics rather than one of unusual heat economy.

It is, therefore, significant that the trend in thought with respect to locomotive development in Germany now appears to be swinging in the direction of intensive development of standard types of locomotives rather than the development of experimental types necessary for the high pressures and temperatures on which major improvements in thermal efficiency depend. Prof. H. Nordmann in a recent article in the Zeitschrift des Vereines deutscher Ingenieure, reviewing a series of tests to determine the performance of the most modern standard locomotives and how far an increase in thermal efficiency can be carried within the limits of pressure and temperature associated today with the standard type of boiler construction, points out that the cost of fuel amounts to only about 21 per cent of the total cost, including capital charges, repairs and wages. A further consideration which has detracted from the prospects of experimental types of locomotives has been the relatively low availability and the fact that engine failures are particularly undesirable at the present time in view of the keen competition offered by other means of transportation. For these reasons the author states that the attractiveness of radically new types of locomotives has decreased materially and, while such developments will not be discontinued completely, they have little chance to progress at the present time.

First cost and maintenance are items of such importance in determining the ultimate economic value of a locomotive that improvements in thermal efficiency and, hence, fuel economy, which effect major increases either in first cost or the cost of repairs, are looked at askance by railway men in America as well as in Germany. In the first place, there is the uncertainty as to whether a certain improvement in thermal efficiency will result in a corresponding increase in fuel economy under every-day operating conditions. Again, there is the uncertainty as to what maintenance costs will prove to be. Probably one of the strongest factors in causing hesitation to deal with locomotives in which radical departures have been made from conventional types of construction is the uncertainty as to reliability which is of no less importance in America than in Germany.

The changes which have been introduced in locomotive construction in recent years have been aimed as much, if not more, at effecting reductions in maintenance and increases in reliability as at improvements in thermal efficiency. American experience, indeed, has proved that practical fuel economy depends in as large measure on proper supervision of the selection, handling and firing of coal as on the thermal efficiency of the locomotive itself. As the result of the intensive campaign for fuel economy during the past twenty years the cost of fuel has become a relatively less important factor in the total cost of locomotive operation than has the cost of repairs. The present situation, therefore, would seem to call for concentrated attention on reducing the cost of repairs. This involves the design of locomotives, but it also calls for attention to organization, methods and facilities for economical repair processes as well.

Mechanical Conventions In 1935

In the July number of the *Railway Mechanical Engineer* we published an interview with a railway executive, in which he stressed strongly the advisability of reviving the work of the various mechanical associations and scheduling conventions for 1935. The last full membership convention of the Mechanical Division of the American Railway Association was held at Atlantic City in 1930; since that time the General Committee has met each year to receive reports from the various committees and transact necessary business. Several of the other mechanical associations have held no meetings during the past four years. During that time there have been many changes in personnel and it promises to be a difficult task to build up the membership and revive the work of the associations to such an extent that they will adequately meet the challenge of changed conditions and new requirements.

The interview in the July number stirred up a considerable amount of discussion and since that time the import of the comments received has been reflected in editorials in each issue of the *Railway Mechanical En-*

gineer. The General Committee of the Mechanical Division, at its meeting in Chicago in June, decided to hold a full membership meeting of the Mechanical Division next year. On September 17 and 18, the International Railway Fuel Association and the International Railway General Foremen's Association held short meetings in Chicago. On September 18 representatives of the various mechanical associations, other than the Mechanical Division, A.R.A., met at Chicago and decided to hold full membership meetings early next May, with a common exhibit of railway equipment and supplies.

Four of the associations, the Traveling Engineers, Air Brake, International Railway General Foremen and Car Department Officers, will hold individual, but simultaneous meetings on Thursday, Friday and Saturday, May 2-4. Four other associations, the International Railway Fuel, Master Boiler Makers, American Railway Tool Foremen and International Railway Master Blacksmiths, will meet on Monday, Tuesday and Wednesday of the following week. It was decided to hold these meetings in Chicago, with an exhibit under the direction of the Allied Railway Supply Association. The conventions are scheduled for early May, since that comes between seasons, at a time when the men can best be spared for the meetings. The central location will make it possible for a large number of members to attend the meetings with a minimum loss of time from their roads.

The assumption apparently has been that the Mechanical and Purchases and Stores divisions of the American Railway Association will hold meetings at Atlantic City in June, with an exhibit. Expressions from railway supply people rather question the desirability of putting on an exhibit if only a short meeting is to be held. There is a pronounced sentiment, also, that it might be better to hold the Mechanical Division meeting and the conventions of the other mechanical associations at the same place, so that one exhibit will suffice for all the conventions.

A number of railway supply men rather question the advisability of putting on an exhibit at a resort city, the feeling apparently being that it would cost less, both in the way of entertainment and setting up the exhibit, if it is held in Chicago, which is centrally located and where most of the railway supply companies have permanent offices or representatives. There is a question as to whether suitable quarters can be secured for such an exhibit in Chicago. These are some of the problems which must be threshed out before arriving at a final decision.

The important thing is that the various associations are taking steps to resume their activities. Changed conditions and the long lapse between meetings make it vitally important to stimulate the work of these associations and get them to function on a more constructive and aggressive basis.

One other thing must be recognized and emphasized. There have been many changes in personnel in the past few years. Something must be done to help the men who have been promoted, and particularly the younger men. The latter have been largely lost sight of in the emergency. Fortunately, some of the older men have sensed the need of encouraging and developing this group. Let us hope that in some way they can definitely organize to draw out and develop these young men, so that they will be trained and fit for taking positions of leadership, as opportunity offers. Committee work, participation in the convention discussions, and the contacts they will make at the meetings, will be most helpful in training them for more responsible positions.

What to Weld—And How?

Railway locomotive and car maintenance practice, as well as reclamation work of all kinds, has been practically revolutionized in recent years by autogenous welding, the great bulk of which is now being done by the oxyacetylene and the electric processes. The whole subject of welding is beset with a multitude of questions. Safety is the first requirement in railway operation and, therefore, the first question regarding any weld relates to its safety and reliability. The next question is economy, since many welds which would be permissible or desirable from a safety standpoint entail a greater cost for material and labor than would be required to buy a new part. Once the mechanical and economic practicability of individual welding jobs is conceded, the question arises regarding what type of welding will give the best results and what detailed method can best be employed in preparing parts for the welding operation and treating them subsequently, if necessary.

An observation of current practice leads to the inevitable conclusion that all kinds of welding, good and bad, too extensive and too limited, are found in railroad shops and enginehouses at the present time. The final natural question, therefore, is: How can any railroad expect to achieve the best results with welding unless this important operation is put in charge of a specially trained general supervisor of welding who can co-ordinate the experience of mechanical supervisors on the entire system, check detailed welding operations with similar ones on other roads and with the most advanced methods in other industries, develop a standard welding practice folio for use at all points on the system, supervise the training of welding operators and see that periodic checks are made of their work?

Even a casual inspection of welding practice at many railroad shops and terminals indicates the widely divergent ideas regarding what can and cannot be done and emphasizes the necessity for a co-ordinated practice which will be well above present levels in many instances. Welding operations are being performed at

some shop points which are said to be impossible by supervisors at other points. Sometimes this difference of opinion exists at a single repair shop. For example, a general foreman at a small railroad shop recently examined a particular job and expressed the opinion that it could be welded. On assigning the work to his welding foreman, however, the latter explained that a similar welding operation had been performed only the preceding week and proved to be unsatisfactory.

All kinds of welding operations, building up worn parts, and facing certain parts with hard metal to give increased wearing properties and service life, must be carried on daily at railway repair shops. It is futile to expect that the best results of these operations can be obtained without an expert knowledge on the part of the men who do the work, supplemented by general instructions from some central authority familiar with what can be done and how. As previously suggested, the training of welders and periodic checking of test welds, also, should come under this same central authority. Only a few of the larger railroads have in the past made a practice of employing a general supervisor of welding and some of these men have been reduced to the ranks or secured employment elsewhere, owing to retrenchment programs which have so greatly curtailed supervision in railroad mechanical departments. It can hardly be questioned that this policy is a mistake and costly in the long run, since the supervisor's annual salary can readily be lost by mistakes of omission or commission on two or three important welding jobs.

Locomotive Smoke Elimination

Less than four years ago a Railroad Smoke Association was formed in Hudson County, N. J., to co-operate with the county administration in a campaign to eliminate smoke. The results have been most gratifying, the nine railroads serving this section making a particularly good record—a record which can be used to stimulate greater effort for improvement on the part of the industries and householders in that county.

In studying the monthly records of the railroads for these years it is interesting to note that some roads, which during the early part of the period were consistently near the bottom of the list, have shown a reversal of form and now stand near the top, although all of them have shown a marked improvement during the period. It has required a real effort to do this, with changes in methods and practices, but it has demonstrated clearly that it is possible to operate locomotives with very little, if any smoke. One road, the Lehigh Valley, headed the list four months this summer with 0.00 smoke. The Railroad Smoke Association, through its monthly meetings and the efforts of its officers and members, has carried on a steady campaign of education.

It may have cost something to make this record—undoubtedly it has. In some instances the grade of fuel has been changed; improvements have been made in the equipment and its conditioning. The elimination of smoke, however, means more perfect combustion and while accurate figures are not available, it is believed that the reduction in fuel consumption has more than offset the increased expense.

It is quite probable, also, that more or less intangible factors have resulted in savings in other directions. Industrialists, for instance, are quite generally agreed that cleanliness and orderliness are important factors in efficient production. The effort to eliminate smoke, and its accomplishment, apparently has a psychological effect upon the enginemen and does much to make them more careful as to all details of locomotive operation; in other words, there is an effect upon the morale, which while intangible, is believed to represent real and substantial improvement in more efficient operation.

It is claiming too much to say that the public appreciates the improvement which has been made—or that it even realizes that there has been an improvement in the reduction of locomotive smoke. This is not to be wondered at. The whole tendency in the business world in recent years has been to cater to the finer and more artistic instincts of the public. The manufacturers of common, every-day articles, which are to be found in the five and ten cent stores, have gone to considerable expense to design their products more artistically and to package them in an attractive and pleasing way. The Metropolitan Museum of Art in New York has an industrial division to assist manufacturers and merchants in these respects.

Stores—even the smaller ones and those away from the metropolitan centers—go to considerable effort to make attractive and artistic window displays, or to arrange their products on the counters and shelves in such a way as to appeal to the buyer. Moving picture theatres, restaurants, hotels and transportation companies have studied to make their facilities more inviting and comfortable; the decorator and artist have had a large part in this development. The same thing is true of the automobile manufacturer; even the makers of machinery and machine tools have emphasized the easy lines and more artistic appearance of their products. The artistic appeal is no more pronounced than in the advertising pages of the popular magazines and this is even carried over in certain respects into the daily newspapers. City administrations, although they may be confronted with serious budget difficulties, have not entirely lost sight of the necessity of keeping streets, highways and parks clean and orderly.

Under such circumstances the public expects that the railroads and the industries will do their part in reducing and eliminating objectionable features such as noise, smoke, objectionable odors and noxious gases. Indeed, the railways, if they do not do their part in improving these conditions, will be seriously criticised. The railroads of Hudson County are to be congratulated upon the showing they have made.

THE READER'S PAGE

Two Sides To This

To the Editor:

The writer has seen men promoted to supervisors in the car department from the ranks of both freight and passenger carmen. In many cases the promotion has been of a coach carpenter to supervisor in the freight-car shop, the party promoted being a first-class coach carpenter but inexperienced in the freight-car department. This meant a reduction in the output and, in many cases, a big loss to the company because of the man not knowing how to handle foreign equipment according to A.R.A. rules.

On the other hand, if the promotion had been made from the freight-car department the party would have had the proper knowledge of such handling which would have been for the good of the company.

Passenger-car work requires very little knowledge of A.R.A. rules, while everything pertaining to freight-car work requires a thorough knowledge of them.

W. H. Shiver.

Tread Wear And Flange Height

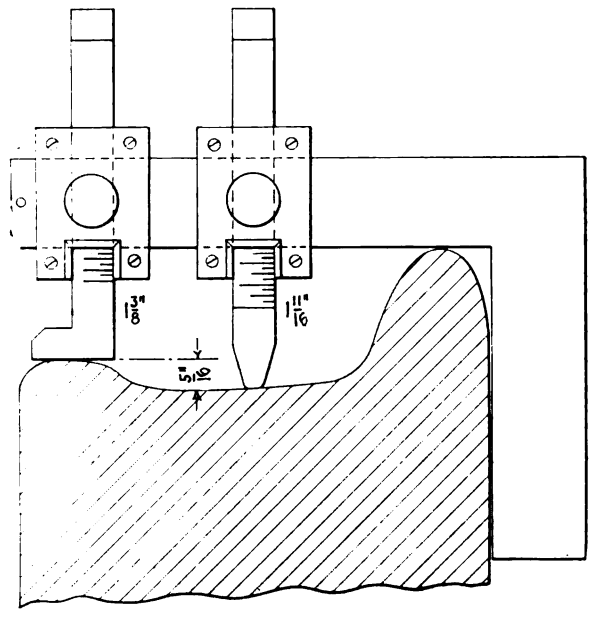
To the Editor:

In the February issue of the *Railway Mechanical Engineer* you had an article on a gage to show tread wear.

From what I understand of tread wear, this gage is showing a measurement of flange height only and not tread wear. A flange height of $1\frac{11}{16}$ in. does not mean a tread wear of $\frac{9}{16}$ in., but whatever the difference between the highest and lowest parts of the tread, as I have tried to show in the sketch.

The gage I have illustrated was designed by F. A. Webb, car machine shop foreman of the Southern Pacific at Sacramento, Cal., a man who has spent 50 years on wheels and tires and who is an authority on his line of work. This gage is in three parts: a square of $\frac{1}{8}$-in. sheet steel and two movable heads with graduated slides. These are moved to the lowest and highest points of the tread so that the maximum wear might be obtained. In the sketch one gage shows $1\frac{11}{16}$ in. and the other $1\frac{3}{8}$ in. The difference of $\frac{5}{16}$ in. is the tread wear, and the $1\frac{11}{16}$ in. is flange height.

J. C. Hanssen.



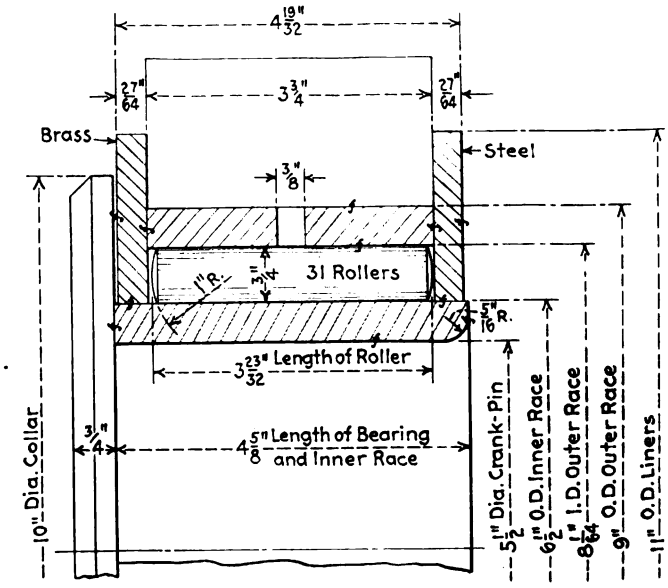
Gage for measuring both tread wear and flange height

Roller Bearings For Locomotive Rods

To the Editor:

A considerable number of the locomotives built in the past few years have been equipped with roller bearings on the axles of engine or tender trucks and in this field are giving such satisfactory performance that their advantages are quite generally recognized. In a few cases roller bearings have been applied also in driving axles but practically nothing has been accomplished in connection with their use for main and side rods until very recently.

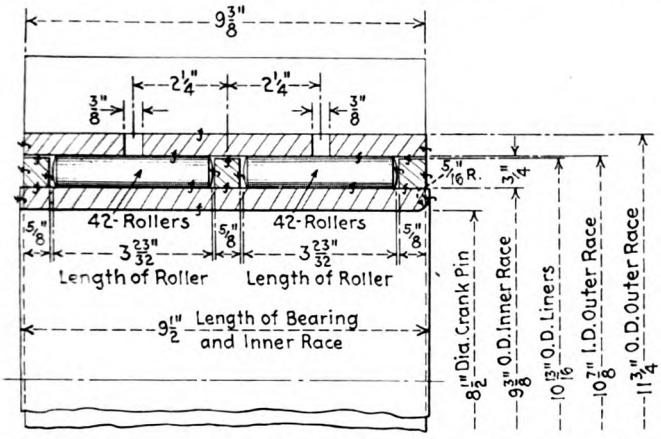
Floating rod bushings of both the solid and divided type were introduced several years ago and have attained wide usage. The solid type of floating bushing, if properly fitted, is a decided improvement over the pressed-in bushing. However, they very often are not properly fitted, especially at renewal periods in enginehouses and as a consequence, have caused considerable trouble. The divided, or split, type of floating bushing is much more reliable, but rapidly accumulates lost play unless carefully machined at the joints.



Roller bearing as applied to D. & R. G. W. side rods

While roller bearings have been considered for rod work, it generally has been thought that the service

would be too severe. Several years ago, however, the D. & R. G. W. decided to find out definitely whether roller bearings would stand up in this service. Accordingly, on November 13, 1931, a set of rollers was applied to a side rod at the left back crank pin on engine



Roller bearing as applied to D. & R. G. W. main rods

1523. This was perhaps the first installation of roller bearings for such service in this country. The locomotive was of the 4-8-2 type, built in 1923, by the American Locomotive Company. It has a weight of 267,000 lb. on the driving wheels, 28-in. by 30-in. cylinders, 63-in. drivers, 210 lb. boiler pressure and a rated tractive force of 66,640 lb.

The crank pin was 5¾ in. diameter with bearing 4½ in. long. A plain cylindrical bushing of vanadium steel, hardened and ground, was pressed into the rod, and a sleeve of the same material, 6¼ in. outside diameter, was pressed onto the crank pin. The twenty rollers were of a plain cylindrical design, ¾ in. in diameter by $3^{29}/_{32}$ in. long, made of vanadium steel, and mounted in a bronze cage with separation strips, $^{11}/_{32}$ in. thick between the rollers.

The service results were entirely satisfactory until, after a few months, the bronze age broke into several pieces. The cage, and a few of the rollers which showed signs of spalling, were removed at this time and the entire space filled with rollers, without any cage. These are still in service and have made approximately 50,000 miles. Analysis of the rollers removed showed that the tempering was not uniform. These had been made from a scrap piston rod.

In view of this experience it then was decided to tackle a harder job and in May, 1932, a set of rollers, made in the same way, was applied to the back end of the main rod on one side of engine 1518 of the same class. The general design is shown in one of the illustrations. No trouble of any kind was experienced with this application until July, 1934, when they were removed on account of wear, after about 30,000 miles. Both of these engines were used in heavy freight and passenger service.

On January 22, 1934, a set of rollers of the same design, but made of chrome-nickel steel, was applied to the side rod at the left back pin of engine 1700. This was a 4-8-4 type locomotive built by the Baldwin Locomotive Works in 1929. It has a weight of 252,000 lb. on the driving wheels, 27-in. by 30-in. cylinders, 70-in. drivers, 240 lb. boiler pressure and a rated tractive force of 63,700 lb. This locomotive is used in fast passenger service on 450-mile runs. Up to the present time, after about 35,000 miles, no trouble of any kind has been experienced. The lubrication used for all these bearings has been regular crank-pin grease, the same as used on all other engines. No dust washers or special fittings were used.

An interesting item in connection with these roller bearings is that the development of lateral play has been markedly less than with the conventional bearing. The service which has been given by these applications—which must be considered as rather crude—is such as to leave no doubt in regard to the practicability of rollers for any bearing in locomotive service. As a measure of comparison, the mileage which has been secured from floating bushings in comparable service averages 15,000 for main rods and 10,000 for side rods. Results thus far have been so satisfactory that we are now preparing to make a complete application to all side-rod bearings on another locomotive, and will also make further applications to main rods.

P. G. WITHROW,
Mechanical Engineer, D. & R. G. W.

* * *



Covered hopper car built by American Car & Foundry Company for bulk shipment of carbon black

Length inside	45 ft. 10½ in.	Truck wheel base	5 ft. 6 in.
Width inside	9 ft. 6 in.	Capacity	3,000 cu ft.
Height—rail to top running board	12 ft. 10⅝ in.	Axle journals	5 in. by 9 in.
Height—rail to eaves	11 ft. 10 in.	Light weight	50,000 lb.
Center to center of trucks	37 ft. 0 in.	Load limit	68,000 lb.

With the Car Foremen and Inspectors

Loading and Shipping Mounted Car Wheels

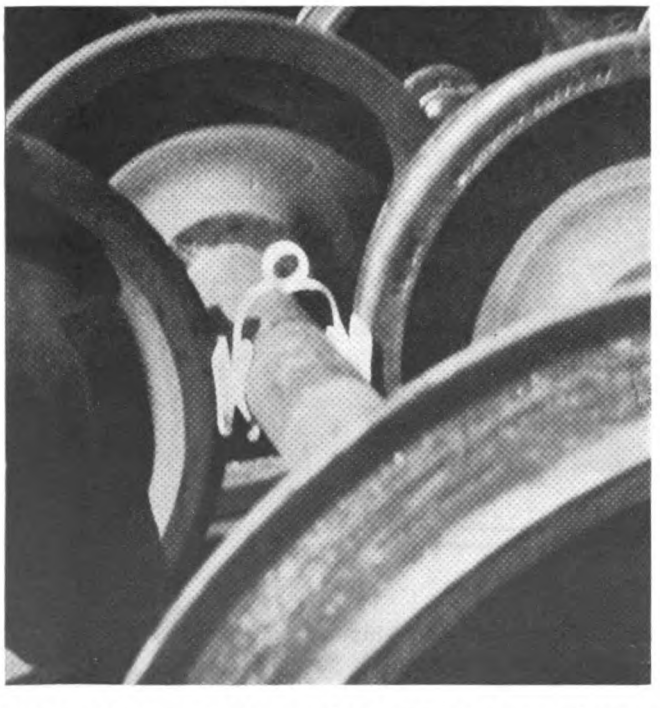
THE safe transportation of mounted car wheels between wheel shop and user point is always a more or less troublesome problem. The chief difficulties encountered are blocking, not only to prevent the wheels being knocked off the car in switching and train movements but to prevent surge movements of the wheels on the car. Adequate blocking to prevent inadvertent unloading in transit can be obtained by the use of substantial and well secured end and intermediate blocking. Preventing surge movements in the load and the resultant damage to axles in particular is much more difficult.

Slack develops in the load from indentations made by wheel flange and tread in end blocking, by more or less shift of end blocking, by indentation and shift of intermediate blocking. None of the ordinary blocking methods in use will prevent this shifting, and the greater the amount of slack developed the greater becomes the wheel movement impact, resulting in a still further increase in slack until there may be a total of several inches. The most serious consequence of this surge movement, however, is flange cuts in the axle of the next pair of wheels. These axle cuts are often so deep and extensive that the axle is or should be scrapped, as if returned to service it constitutes a serious menace in that a progressive fracture is likely to develop, leading to failure in service. Furthermore, each of these axle dents increases the total slack in the load by an amount equal to its own depth, which may be one-eighth inch or more, increasing the surge movement and the consequent damage to axles. A mild form of a flange-cut axle is shown in one of the illustrations. In some cases, new axles are so badly flange-cut in transit between wheel shop and user point that they have to be scrapped. Progressive fractures starting from these flange cuts not infrequently result in broken axles.

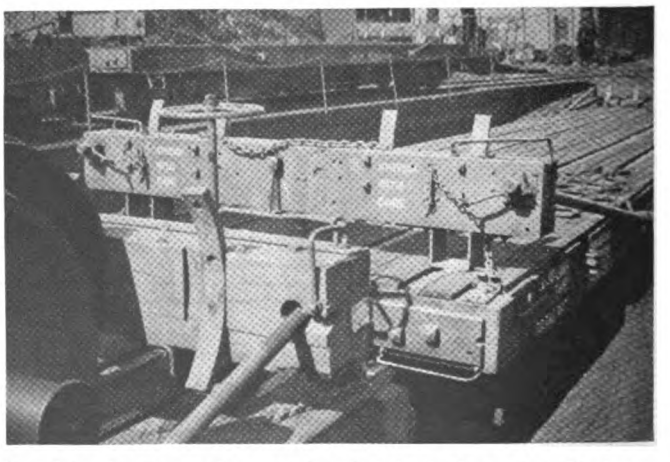
This serious trouble can be eliminated by the use of the axle protector, illustrated, which is a device patented by P. P. Barthelemy, assistant master car builder of the Great Northern, and now being introduced for general use on the railroads by the Universal Draft Gear Attachment Company, Chicago, Ill. As will be noted, this device consists of two malleable iron spacer blocks coupled together by a simple retaining spring arrangement. Each spacer block has a curved surface to engage the face of the axle, the radius of the curve being about that of the largest axles ordinarily shipped. The other side of each spacer block is trough-shaped to the contour of the wheel flange. The spring serves to keep the protector in place, and the trough for the wheel flange prevents the flange from coming in contact with the axle. This device offers so large a contact area to the flange that cutting slack becomes negligible. The protectors are easily applied and ordinarily will withstand many years of service.

After extensive experiments in loading and blocking wheels, the special wheel car illustrated was built and with the axle protector just described has served to eliminate blocking troubles. This special car has been found very effective, as besides making a much safer load than can possibly be had on the ordinary flat car it serves to reduce greatly the loading and blocking expense below that of the usual methods employed. Since ordinarily the shipment of bad order wheels to the wheel shop equals the number of OK wheels received, there is no empty car haulage nor serious idle car time.

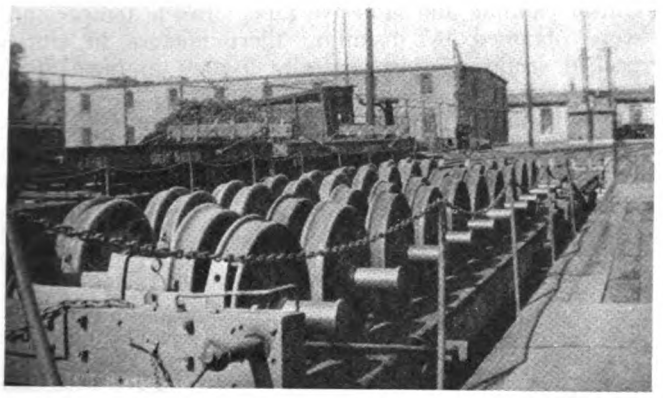
Metal-covered tracks are bolted to the car floor for convenience in loading and unloading and to insure proper lateral spacing of the wheels. The spread of these tracks is such that each wheel clears the end of the journal of the next pair thus obviating possible flange damage to journals that might otherwise occur, particularly when the load consists of mixed axle sizes.



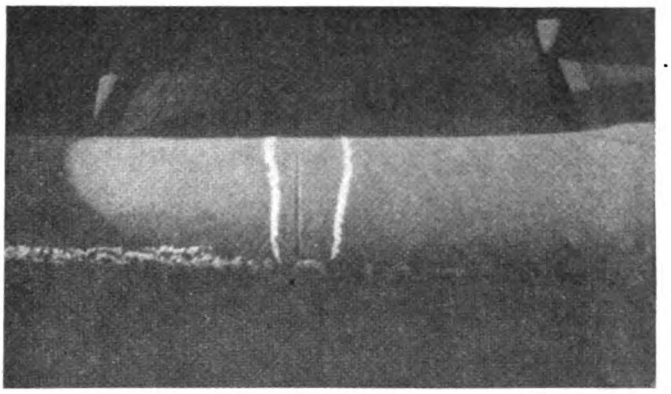
Universal axle-protecting device as used to prevent damage by flange cutting



Special wheel car, the use of which is designed to eliminate blocking troubles



View of the special car as loaded with wheels ready for shipment



Car axle damaged at the center due to flange cutting while in transit on poorly blocked wheel car

With the guiding tracks mentioned each pair of wheels is automatically lined up on the car and may be easily rolled in place by one man, with no shifting for alinement on the car necessary. Better packing of the load is also more easily attained. This is particularly advantageous where wheels are loaded from one end of the car, be it by depressed track or hoist; the same applies to unloading.

The end blocking, the most important feature insofar as the safety of the load is concerned, consists of channel-re-enforced wood beams, secured to the car by means of heavy rods. The end of the rod passing through the beam is provided with a long thread and wood filler beams are also provided to compensate for any varying end projection which ordinarily occurs. The lower end of the rod is anchored in a large forging which is in turn securely fastened to the side sill of the car. The nut on the lower end is drilled and pinned to the rod, and lugs are welded to the rod to prevent rod rotation. When the end beam is removed the rods drop clear of the car floor so that they will not interfere with side loading or unloading when and if that becomes desirable.

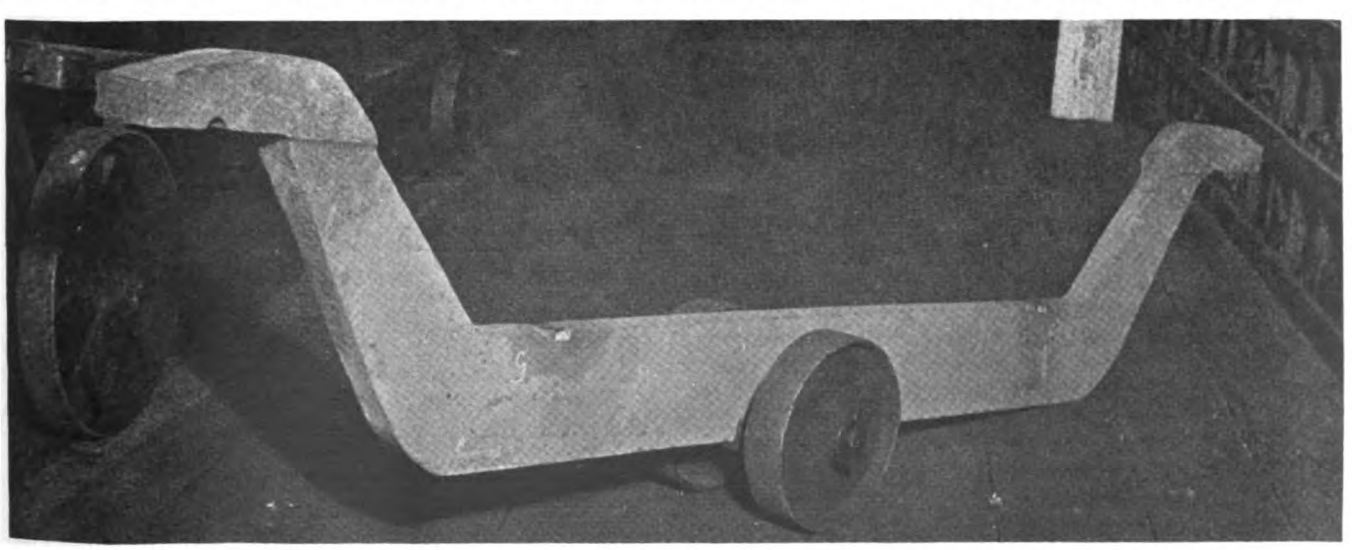
A light crank is welded to the nut on the outer end of the rod for speed in removal and application, a wrench being necessary only for loosening or final pulling up of the nut as the case may be. A safety ring attached to a small chain is thrown over this crank to prevent the nut turning.

To prevent any bouncing of the wheels due to severe train surges or to careless switching, steel strap arcs bent to the contour of the wheel tread are secured to the end beams. A small chain is fastened to the top face of the beam so that it may be easily lifted on and off the car by means of the wheel hoist.

The foregoing has dealt with single-deck loading. Double-deck loading of mounted wheels is practiced on a number of roads and is covered by A.R.A. loading rules. What has been said regarding secure blocking applies also to this method of loading, differing somewhat, due to difference in load conditions. Where both wheel-shop and user point are equipped with suitable hoists for double-deck loading and unloading, a considerable economy results due to reduced car haulage, particularly where the haul is long and the wheel renewals are extensive. Absence of adequate loading equipment, with using conditions comparatively light, and the extra transit hazards to the double-deck over the single-deck load have had a tendency to limit the extensive use of two-tier loading.

Car-Shop Dolly

A CONVENIENT dolly which has many uses in and about car shops is shown in the illustration. It is made of two warehouse truck wheels, mounted on an axle, with a depressed center, to which is bolted a short length of channel iron cut from a scrap brake beam.

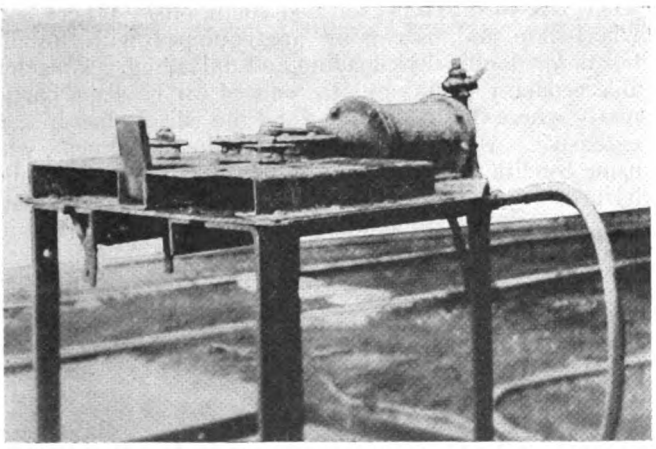


Convenient, two-wheel dolly used in moving heavy passenger-car truck equalizer, long steel sheets, etc.

The wheels are set to "toe in" slightly at the bottom to facilitate turning. In addition to the use illustrated, which consists of moving a relatively heavy passenger-car truck equalizer, this dolly serves effectively for the safe and ready movement of other heavy or awkward parts, such as long steel car sheets.

Pneumatic Pipe Bender For the Car Shop

AN efficient pipe bender, as shown in the illustration, can be easily constructed for use in the car shop. It consists of a 10-in. air brake cylinder mounted on a 30-in. table. A half portion of a ten-inch sheave wheel is attached to the piston push rod, the sheave wheel being of a size large enough to engage a piece of one and one quarter inch pipe. Several holes are drilled in the top of the table into which two sheave wheels, mounted on one and one quarter inch pins are dropped. The section of pipe that is to be bent is placed against the two sheave wheels and the piston of the cylinder moved out by air pressure to give the desired bend.



An easily constructed pipe bender

Aluminum Roof Paint Reduces Passenger-Car Temperatures

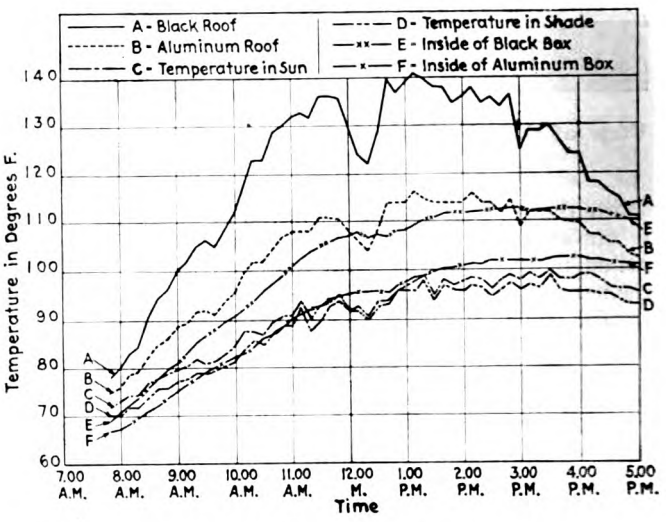
*By C. F. Griffith**

IN order to determine the relative merits of aluminum paint in comparison with the conventional black paint which is generally used on the roof of railway passenger-train cars a test was made in the following manner.

Two steel boxes, 18 in. by 18 in. by 18 in., were made of 14-gage steel and insulated throughout with three layers of three-ply Salamander insulation. Both boxes were painted in the usual manner with priming and black coats, while one of them was given a final coat of aluminum paint over the regular black paint.

Provisions were made for obtaining the temperature on the top sheet of each box, the inside temperature of each box and the temperature of the atmosphere in the sun and shade. Roof-sheet temperatures were obtained by holding the thermometer bulb in contact by the use of cotton padding and adhesive tape. Inside temperatures were obtained by installing thermometers in cotton-packed stuffing boxes centrally located in one side of each box.

The results of this test after being tabulated and plotted are shown in the accompanying diagram. As the material used in constructing, painting and insulating the boxes is similar to that used in railway passenger-car roofs, it is reasonable to assume that the interior tempera-



Temperature records in test of paints for passenger car roofs

tures observed in the test are comparable with those prevailing between headlining and roof sheets of railway cars when outside temperatures are equivalent to those shown. The temperatures observed and recorded in this test would have been much higher were it not for the fact that light to heavy fleecy clouds obstructed the sun rays at frequent intervals after 9.30 a. m. This interference is clearly shown in curves *A* and *B*.

Particular attention is called to the difference in interior temperature as shown by curves *E* and *F*, which was as much as 10 deg. F. for a considerable portion of the test. This shows conclusively that aluminum paint on the roof of a railway car will make possible the maintenance of lower temperatures inside of the car during periods of sunshine. Conversely, the aluminum painted roof should reduce the heating load in the winter season because of its lesser radiating capacity as compared to the black painted roof.

Reclamation of Air And Signal Hose Couplings

IT is essential that a careful inspection be made of air brake and signal hose couplings after they have been stripped from defective hose in the air brake shop and before they are reapplied to new tubes. They should be thoroughly cleaned before they are gaged and otherwise inspected and an excellent way of cleaning them is by placing them in a container as shown in the accompanying photograph and permitting them to remain in a "lye vat" for about 30 min. This will remove any

* Electrical engineer, Missouri-Kansas-Texas.

grease, paint or other substance from the coupling and will also clean out the gasket seat.

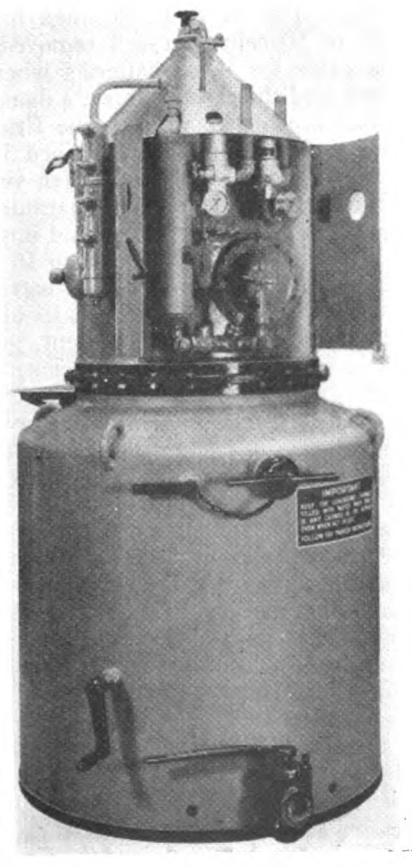
The same procedure is recommended for hose clamps. When all grease and paint is removed they can be more carefully inspected and cracks or defects can be more readily detected, esperially around the bolt holes.



Containers for air brake hose couplings and clamps

Oxweld Acetylene Generators

THE Linde Air Products Company, New York, has developed two new Oxweld acetylene generators, one being a small generator of the portable type and the other a stationary generator of much larger capacity. The portable generator, designated as Oxweld type MP-4, has a capacity of 150 lb. of carbide and is rated to produce 300 cu. ft. of acetylene per hour. It weighs 750 lb. empty and 2,250 lb. fully charged. This generator has the largest rated gas capacity thus far approved for portable service and the smallest dead weight per unit of producing capacity.



Oxweld portable acetylene generator, type MP-4

The feed is of the gravity type with a self-contained feed-control unit bolted to the inside of the carbide hopper. The feed valve is adjusted to deliver gas at a pressure of about 13 lb. per sq. in., but this may be varied within a range of 2 lb. by external adjustment. At all rates of generation the pressure variation within the generator is not over ¾ lb. and this slight variation is nullified in the service line by a new type of regulator, Oxweld type R56. A simple filter unit, also within the hopper shell, is built into the rear of the regulator. The generator is designed to provide simple and rapid means for emptying and recharging, with ready accessibility of parts and easy maintenance.

The new automatic stationary generator, known as Oxweld type MP-5, is a high-capacity, medium-pressure model with a rated delivery capacity of 1,000 cu. ft. of acetylene per hour. In general appearance and principle it is similar to the portable type MP-4 generator. Both machines are listed by Underwriters Laboratories, Inc.

The hopper is provided with eyelets around the top so that it can be removed with a block and tackle. The regulator is Oxweld type R-57. A relief valve with an outdoor vent line is provided for the back-pressure valve and two other relief valves with a common outdoor vent line are provided for the generator chamber. A funnel and a 3-in. lubricated water-filling valve provide with an interference rod that operates a vent cock makes it impossible to add water until the cock is opened to allow for the displacement of gas.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for Passenger Refrigerator Cars with Retaining Pipe Disconnected

N.R.C. passenger refrigerator car 317 and forty-five other passenger refrigerator cars were delivered to the Northern Pacific at St. Paul by the Chicago, Burlington & Quincy during June, 1932, with the retaining pipe disconnected or emergency reservoir pipes disconnected and capped, or both. The Northern Pacific finding it necessary to connect these pipes for movement of cars over their line, contended that they were entitled to defect card protection from delivery line to cover. The C. B. & Q. contended that no protection was due and declined to issue defect card to cover. There being no ruling of which the companies interested were aware, the matter was referred to the Arbitration Committee. The N. P. stated that cars referred to usually move into St. Paul in freight trains and again move out over N. P. in freight trains. It was their under-

standing that when either freight or passenger refrigerator cars are handled in freight trains, A.R.A. air-brake requirements, as well as federal safety appliance laws covering operation and condition of air brakes on freight trains, must be complied with. As A.R.A. rules require retaining valves on freight cars, it was contended that when passenger refrigerator cars are handled in freight trains they must also have retaining valves and their air-brake piping properly connected and in operating condition. To comply with these rules it was necessary to place cars on repair track and connect all pipes, involving considerable expense not only in making repairs, but also in switching cars to repair track, testing brakes, etc., for which the N. P. was unable to bill car owner. Request was therefore made of chief joint interchange inspector for defect card to cover, which request was declined. The C. B. & Q. having also refused protection, the matter was referred to the Arbitration Committee for decision. The C. B. & Q. stated that they had received these cars from connecting lines with retaining pipe disconnected and had moved them to St. Paul where they were delivered to N. P. in same condition. They knew of no interchange rule which makes a disconnected retaining pipe a cardable defect and did not consider it as such. Neither did they know of any rule prohibiting handling of cars with the retaining pipe disconnected or broken if brake is operative. Moreover, there has been more or less trouble on account of slid flat wheels under these cars in the past and it was evident that the thought of decreasing dangerous slid flat wheels prompted connecting lines to disconnect retaining pipes. Had retaining pipes been connected up, car owner could not have billed, neither could defect cards have been obtained from delivering line and, therefore, expense would have had to be assumed by them. C. B. & Q. does not use retainers on St. Paul line and simply passes cars along to N. P. in same condition as received from connecting lines.

In a decision rendered October 26, 1933, the Arbitration Committee said: "This is not a defect cardable in interchange. The company electing to connect or disconnect retainer or emergency reservoir pipes on passenger equipment cars for operation in freight or passenger trains must assume the expense incurred."—*Case No. 1731, Northern Pacific vs. C. B. & Q.*

Storage Batteries Damaged or Destroyed—Passenger Rule 22

A Texas & Pacific car moved in interchange service to the Erie at Chicago and thence to Jersey City, N. J., for discharge of lading. While car was on Erie dock electric lighting storage batteries and axle generating equipment were flooded due to unusually high tide. The T. & P. found one set of Edison A-4-H amp. storage batteries damaged beyond repair and requested defect card protection. The Erie offered to furnish a replacement set of batteries, either A-6 or A-6-H, of the same manufacture and approximate age, adjustment to be made based on depreciated value of batteries involved. Offer did not meet with approval of T. & P. as they wished to maintain their standard. The T. & P. further advised that test showed that eight battery cells were destroyed and balance could be repaired. The Erie acknowledged responsibility, but requested date on which batteries in question were manufactured with detailed statement showing hours consumed in making repairs. Also, owner was asked to allow credit in accordance with Edison practice for eight battery cells destroyed. The T. & P. would not agree to settlement on basis of depreciated value nor allow credit on basis of Edison depreciation code. It is desired that Arbitration Committee rule as to the propriety of settlement being based on depreciated value of cells in question and, if not, whether Erie should be allowed credit for destroyed cells in accordance with Edison code. The T. & P. cited finding damaged equipment on arrival of car at Ft. Worth and stated that they could not agree to accept a change in battery standards, and furthermore stated that damaged batteries had been reconditioned before exchange offer was received. Detailed bill showing cost of repair showed that it was necessary to renew eight Edison A-4-H cells out of a total of twenty-three to recondition battery which was purchased new in 1917. The Erie contended that charge against them for the eight cells renewed should be depreciated 69 per cent to cover 15 years expended life in accordance with latest adjustment guaranty published by the Edison Storage Battery Company which covers a life period of 16 years on a percentage scale allowance but excludes cells abused, lost or destroyed. The T. & P. contended that the Erie was responsible for the full cost to repair damage which was kept down to a minimum. The road has approximately 75 sets of batteries of this type of equal or greater age in operation which are at all times in first-class condition with cells rebuilt by manufacturer as required. Under A.R.A. interchange rules many car parts subject to progressive wear or deterioration which when renewed under like conditions are chargeable at cost without depreciation and we believe there should be no exception in this case. The argument that A.R.A. rental price of five mills per car mile compensates for electrical equipment seems entirely irrelevant since same might apply equally to any other part destroyed under like conditions. The T. & P. declined to allow Erie salvage credit of 50 cents per cell removed due to the ten-year guarantee for these batteries when purchased having expired, and the eight cells were damaged beyond repairs and had no salvage value. The Erie stated that the eight cells in question were obtained in 1917 and that manufacturer's guaranty was for ten year's service. Formerly Edison batteries were guaranteed for ten years, but later, based on experience and improved practice guaranty was gradually increased to 16 years. The Erie offered to settle for damage to a battery acquired in 1917 with ten years' guaranty on basis of current, or sixteen-year guaranty. Under present guaranty list price of cells 15 years old is 31 per cent, or, in other words, 69 per cent of life had been exhausted at time of destruction. Rule 10, Passenger Code, provides charge of five mills per car mile against the road handling car for electric lighting equipment to cover expense of operation, maintenance, depreciation and interest. Charge had been paid for this and other cars. Since T. & P. has had use of batteries or received remuneration for their use on other lines for the past 15 years, it does not seem reasonable that the Erie be compelled to replace them with new batteries and the Erie contends that settlement should be based on the service life which remains in accordance with Edison depreciation code.

In decision rendered October 26, 1933, the Arbitration Committee stated: "There is no provision in the Interchange Rules that a damaged part of car shall be settled for at its depreciated value. Settlement at depreciated value applies only in case of the entire car. The contentions of the Erie are not sustained."—*Case No. 1733, Texas & Pacific vs. Erie.*

In the Back Shop and Enginehouse

Universal Ram Type Turret Lathe

A NEW line of universal turret lathes of the ram type has been announced by the Jones & Lamson Machine Company, Springfield, Vt. These machines, which are of a completely new design and have many new production features, are built in two sizes—1½-in. and 2½-in. bar capacity. Two types of driving units are standard—motor mounted in the cabinet leg with drive through multiple V-belts or a flange type motor mounted integrally with the headstock. These machines may be used either for bar stock or for chucking work.

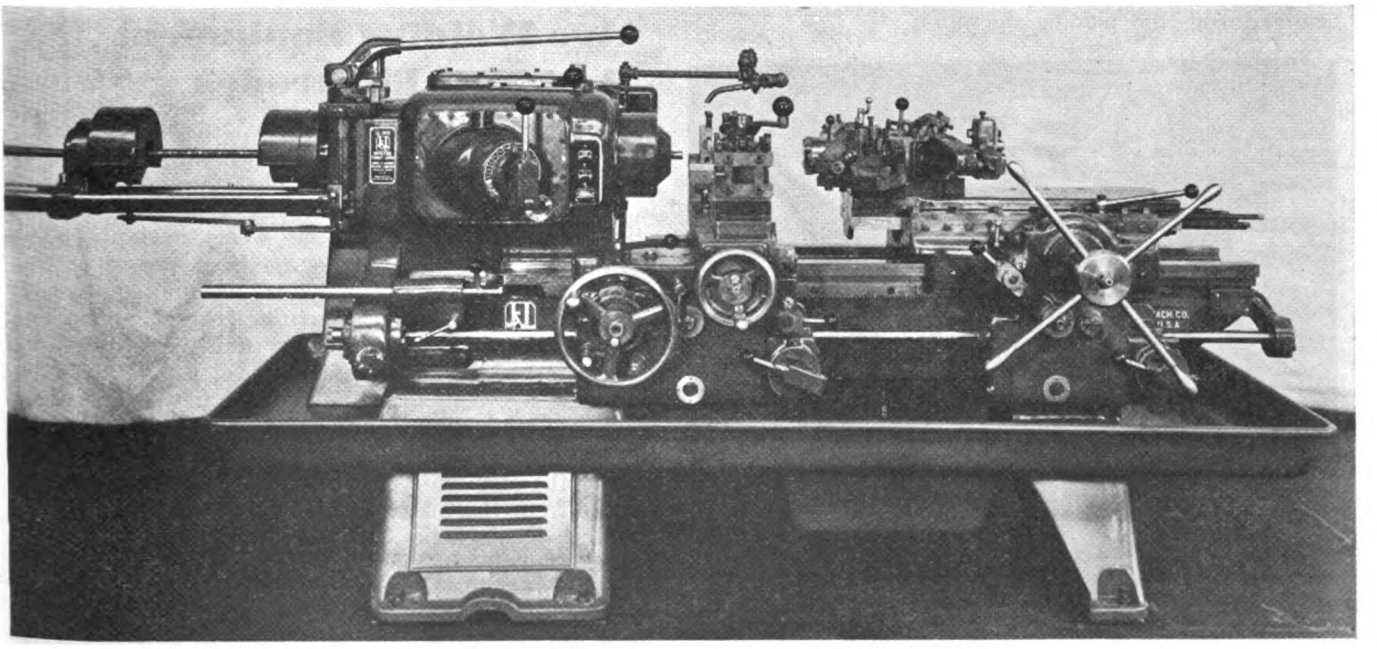
The fundamental purpose of this new design is to permit the use, at the highest efficiency, of the latest types of carbide cutting tools with ample margin for future developments in that field. At the same time there is combined in the same machine all the factors of mechanism, convenience and accuracy necessary to perform ordinary turret-lathe operations with ordinary tools at the highest available efficiency.

The headstock is provided with a single-lever dial selector which controls all speed changes. One lever controls the forward and reverse motion of the spindle and when moved to neutral position an adjustable brake for stopping the spindle is applied automatically. The machine has 12 selective forward and reverse spindle speeds, two ranges of which are standard equipment, namely: 20 to 1000 or 40 to 2000. This range covers the requirements of all cutting tools from carbon steel to carbide. The headstock is lubricated with a splash and filter system, and a visible oil-level gage is located on the front side. The bed is a double box-ribbed casting of rigid construction. The ways are of steel, carburized, hardened and ground. Leveling screws are provided in each leg of the machine.

The carriage is the universal bridge type, made exceptionally heavy for support of the many tools that may be in operation at one time. T-slots in the front and rear of the carriage cross-slide provide for multiple tooling. Standard equipment includes a square turret on the front and a dovetail tool slide on the rear. The square turret is controlled entirely by one lever. Each turret face is drilled so that a multiple tool block, with a capacity of four tools, can be mounted on each face. Maximum multiple tooling for rear-mount tools may be attained by means of dovetail tool blocks fitted to the tool slide. The carriage apron is equipped with a sliding-gear transmission for nine variable longitudinal and cross feeds, all controlled with a single lever dial selector. All feeds can be changed while the machine is running. The range of feeds for longitudinal travel is from .005 to .100 in. and the cross feed range is from .0025 to .050 in. per revolution of the spindle.

The carriage is equipped with a spool stop for longitudinal feeds and an adjustable stop bar, also a spool stop for the cross feed with adjustable stop dogs which will disengage the feed in either direction. The feed for the carriage is automatically disengaged as the carriage comes in contact with a stop, or it can be manually tripped. The feed knock-off is against a positive stop. The apron is provided with a feed reversing lever and a safety friction clutch is provided. For turning or boring tapers a standard taper attachment is bolted to the rear of the carriage. A thread chasing attachment, installed on the carriage apron, is also standard equipment.

The machine is fitted with a hexagon turret with all faces bored, counterbored and drilled for mounting standard bar and chucking tools and is indexed from one posi-



Jones & Lamson Universal ram type turret lathe with motor mounted in cabinet—The lathe is set up for bar work

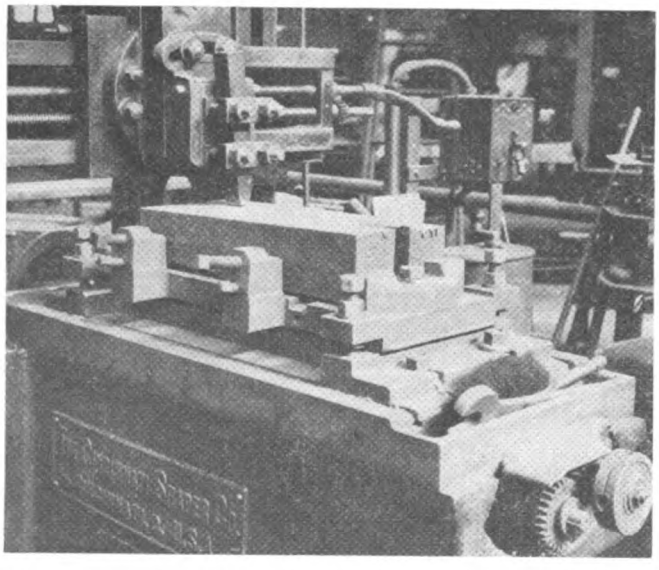
tion to the next with a star wheel. The turret is equipped with an automatic clamp ring. On the return movement of the slide the turret is unclamped, indexed to the next position and on the forward motion automatically clamped. It is equipped with six adjustable stops. The apron for the turret is equipped with nine variable feeds, all controlled with a single-lever dial selector. The range of feeds is from .005 to .100 in. per revolution of the spindle. The feed lever is automatically disengaged as the slide comes in contact with the stop, or it can be manually tripped. The cutting coolant is piped to the turret through the center pin and is distributed automatically to each turret face when indexed to cutting position. The bar chuck has a master collet fitted with removable jaws for different sizes and shapes of stock. By the use of a single lever the operator can unlock the chuck, feed the bar and perform all operations without stopping the machine.

Jig for Planing Shoes and Wedges

AT the Silvis (Ill.) shops of the Chicago, Rock Island & Pacific, two shoe-and-wedge planers are located adjacent to the center aisle of the erecting shop, near the locomotives which are being given general repairs, with a view to saving back travel of material and also conserving the time and extra steps of machinists who are assigned to line shoes and wedges and to notify machine operators what dimensions are required for individual locomotives.

One of the crank planers used for machining shoes and wedges is shown in the illustration, which indicates clearly the construction of a holding chuck especially designed for this service. The base plate of this chuck, which is bolted to the table of the machine, is roughly 15 in. wide by 33 in. overall. An adjustable steel plate, 9½ in. wide by 28 in. long, is machined as shown and provided with suitable stops and holding screws.

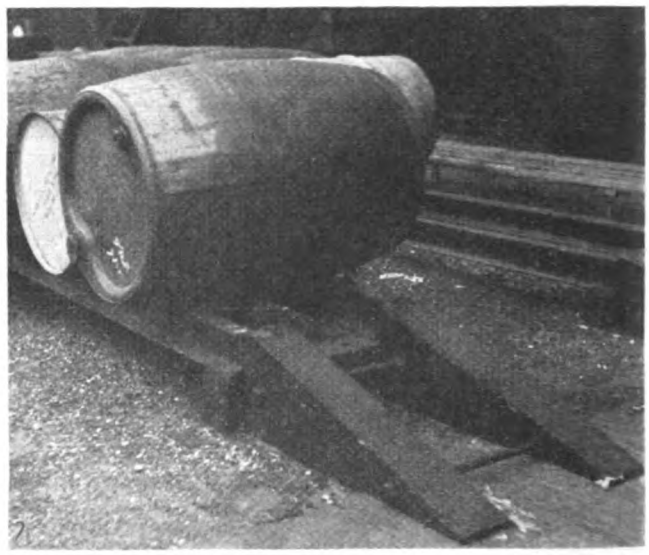
Referring to the illustration, it will be observed that a ¾-in. adjusting screw and lock nut is provided at each corner of the adjustable plate, and this permits easy and accurate adjustment to plane the proper taper on the wedge. Double ⅝-in. holding set screws are provided at four points on the chuck to hold the wedge down firmly during the planing operation.



Cincinnati crank planer equipped with a special chuck for use in planing shoes and wedges

Oil-Barrel Skids

A PAIR of rail skids used in conveniently and safely handling barrels of oil or paint material is shown in the illustration. These skids, as well as the rigidly-supported rails, are used to provide proper storage for these barrels where they can be safely handled by one man. The rails are elevated slightly to keep the barrels off the ground, which prevents rotting or corrosion and also contributes to cleanliness. The skids at the rail ends consist simply of two tapered wooden blocks which are held parallel and in proper alinement by means of two one-inch round iron bars threaded and equipped with suitable positioning nuts. The use of these skids provides a much safer means of rolling barrels from the storage rails to the intershop roadway than loose planks or small timbers which are sometimes used.

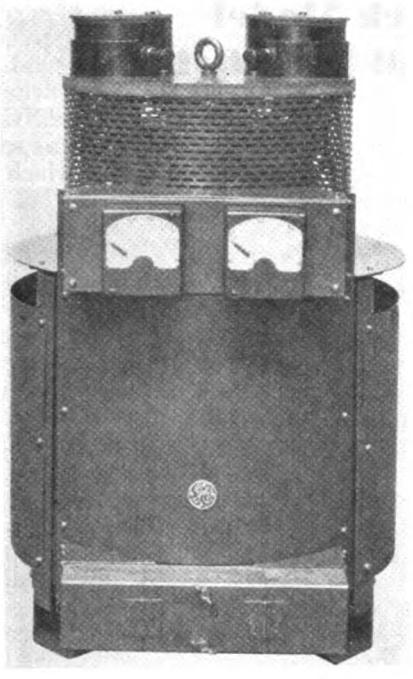


Properly designed rail skids which promote safety in handling heavy barrelled materials

Arc Welding Equipment And New Electrodes

THE General Electric Company, Schenectady, N. Y., is introducing two new lines of arc welding equipment and two newly developed electrodes, one of which is suitable for Class I welds in any position and the other, high-quality, high-speed welds made in a flat position.

In addition to direct-current arc-welding equipment a complete line of G.E. alternating-current arc-welding equipment, including transformer units, electrodes, and automatic welding heads and control, is now available. The new a.c. equipment is intended for heavy current welding—primarily automatic, but equally suited to hand applications. The development of arc-welding electrodes during the last few years has now made it possible to benefit from the major advantage of the a.c. process—absence of magnetic blow in the arc and, therefore, superior quality in the resulting weld. This advantage becomes particularly apparent with the heavier welding currents—above 250 amp.—because of the greater magnetic effect at these currents. Slightly greater welding speeds are possible when using a.c. and full penetration



New General Electric alternating-current arc-welding machine

is obtained in corners and other difficult points.

Transformer units for these machines are available in three sizes having one-hour ratings of 500, 750 and 1,000 amp. Primaries are wound for 220, 440 or 550 volts; 60, 50 or 25 cycles; single phase. Extra attachments are available for obtaining currents down to 10 per cent of the one-hour rating.

A new line of portable, single-operator, arc-welding machines, designated as WD-30, incorporates recently developed refinements of which self-stabilization is an outstanding feature. Each welder is a self-contained unit, having no external reactor, resistor or separate exciter. It is largely due to the self-excited design of these machines that the inclusion of sufficient self-stabilization to provide steady welding characteristics under all conditions is possible. Separate controls are provided for adjustment of welding current and voltage. These controls are located on a panel on top of the machine at a convenient height. On this panel are also located a switch handle for reversing polarity and an instrument with selector switch for indicating welding current and voltage.

A new general-purpose welding electrode, designated as Type W-22, is of the heavily coated or shielded-arc type and produces welds of the quality required for Class I pressure vessels according to the A.S.M.E. Boiler Construction Code. Its distinctive feature is that it may be used in any position—i.e., for flat, vertical, or overhead welding—and at the same time has deep penetrating properties. It is, therefore, equally suitable for butt and fillet welds.

Tests on all-weld-metal specimens made from Type W-22 electrode show the following average results, which more than meet the rigid Class I requirements:

Tensile strength	65,000 to 75,000 lb. per sq. in.
Elongation	20 to 30 per cent in 2 in.
Impact resistance	30 to 45 ft.-lb. (Charpy)

In addition welded joints average 35 to 60 per cent elongation when tested by the free bend method and x-ray, Class I. Because these physical properties are obtained without regard to the position in which the welds are made, there is no necessity for moving the work so that welding may be done in a down-hand position. The W-22 electrode should have a wide field of application in locomotive boiler work.

Another new heavily coated, arc-welding electrode, designated as Type W-23 electrode, can be used in larger diameters (¼, 5/16 and ⅜ in.) and at higher current values than those commonly in use. Another characteristic is the fact that welds fuse uniformly with the side walls of the joint, thus saving the time and labor ordinarily spent in chipping out slag from pockets at the line of fusion. On most work the production rate is greater than with other heavily coated electrodes and two to three times the rate with bare or lightly fluxed electrodes. Welds are smooth and of excellent appearance and possess high tensile strength, density, ductility and resistance to impact and corrosion, more than meeting the requirements for Class I (A.S.M.E. Boiler Code).

Difficulties and Opportunities Of Enginehouse Foremen*

IT is rather difficulty to prepare a balanced paper on the difficulties and opportunities of the enginehouse foreman, as at the present time the former seem to so completely dwarf the latter. The depression, from which we hope that we are emerging, has greatly added to and enlarged his difficulties and the abolishing of positions, consolidations of work, elimination of terminals have considerably changed his outlook, particularly so far as promotions are concerned.

Among the difficulties I would list the effect of the depression on the safe performance of the worker. Under seniority rules and with drastic force reductions, the percentage of elderly employees has greatly increased. These men with years of experience are valuable and faithful employees but it is a fact that many of them refuse to admit or concede that they are less active and alert than formerly and for that reason have to be more closely watched and more carefully supervised to prevent personal injuries.

Constant and Alert Supervision Essential to Safety

It is also a recognized fact that without constant and alert supervision mechanics will unconsciously drift into unsafe practices. This is especially true when it is close to departing time for a locomotive and work is uncompleted. Our safety department heads, as well as higher mechanical officials, hold the foreman responsible for injuries in his department.

Of our few injuries, a majority are caused by employees doing something against existing instructions, and a close investigation will show that the particular individual has not only probably indulged in the unsafe practice before, but that it was only good fortune and breaks that prevented his injury at some previous date. We don't hear much about the injuries we prevent, because that is part of our business and what we are trained and paid for. It is the injury that is not prevented that holds the limelight.

The Form 87 report covers engine failures. On the Santa Fe, we class as an engine failure a passenger train delayed five minutes and not making up the lost time on the division; also a freight train delayed 15 minutes and not making up time on the division. In other words, something our inspectors might have seen or possibly a different handling of the situation by the engineman.

* Abstract of a paper presented by D. R. Cook, roundhouse foreman, Atchison, Topeka & Santa Fe, Richmond, Cal., before the Pacific Railway Club, on June 14, at San Francisco, Cal.

A mechanical inspector spends 20 to 30 minutes on a locomotive, with its thousands of parts. Due to being familiar with the different locomotives, he is well versed in knowing what is apt to cause trouble. On the outgoing inspection, he spends another 30 minutes, but 15 to 20 of this is on the air test. Under such conditions, he may slip up on something which is very embarrassing to explain.

Another difficulty, which may be traced to the depression, is the practice on many railroads of lengthening out the mileage between shoppings. This practice frequently results in increased maintenance work which is thrown on an enginehouse that, because of reduced force, is not in a position to handle the work properly. But, I believe, it is a good, safe practice, if not carried to extremes and will result in reduced maintenance cost.

All Foremen Think They Need More Men

There is something peculiar about enginehouse foremen. I have yet to meet one who does not think he needs more men and if he were given all the men he wanted I don't believe it would increase his miles per failure or cut down his terminal delays. I am firmly convinced he would increase his enginehouse expense, both as to engine handling and maintenance, to an unreasonable point.

Enginehouse foremen are infected with hobbies. I recall one foreman of my acquaintance who was always setting valves, another who every time I went through the house had the engine trucks out of two or three locomotives and still another who kept about half the force busy on main rods.

As the enginehouse foreman is practically the master mechanic's eyes for getting proper information for monthly power meetings, it is necessary for him to keep a record of each individual locomotive as to its mechanical condition. There are many jobs he is figuring on doing at the first opportunity, he being governed in this by the length of time the engine will be in and how other work lines up. My particular hobby has been trying to avoid the letters we get covering things that should have been done.

Statistics are just like a barb-wire fence around some green pastures. They fiercely and ruthlessly give you your cost on many items as compared with the entire system and other divisions. In other words, they show you what you are really doing—not what you think you are doing. If you are not up with the system average something is wrong and the comparative statement shows about where it is.

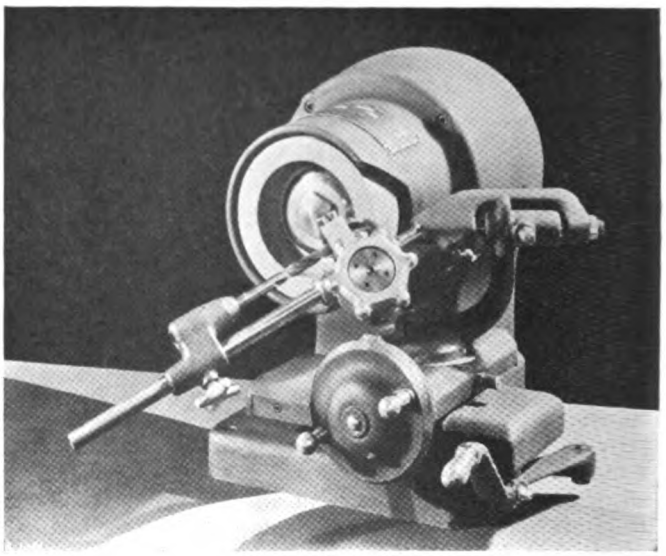
Comparative Statistics Provide Competitive Urge

About a year ago our division was running an ex-excessive cost of rod bushings. Our master mechanic, after carefully checking the figures, came to the conclusion it must be due to wedges. We had been receiving no reports from enginemen on wedges but on checking up on our Pacific-type locomotives we found the main wedges in good shape, but the front and back not properly adjusted. This was putting a strain on the bushings and after being corrected, put our rod cost where it belonged.

An enginehouse foreman has unusual opportunities for service. He is literally on the firing line. The back-shop foreman works more or less by theory, but the enginehouse foreman has before his eyes daily the practical application of those theories. He sees every result of changes in repair work in the back-shop and he is, therefore, in a position to make valuable suggestions for improvement. He is also in a position to see that repair material gives the full maximum service before being replaced.

Bench Model Small Drill Grinder

WILLIAM SELLERS & CO., INC., Philadelphia, Pa., has brought out a self-contained electric drill grinder of the bench type which is designed to take care of small drills ranging from 1/16 in. to 1/2 in. in diameter. This tool, which is known as Sellers No. 05D drill grinder, is driven by a direct-connected, constant-speed, built-in electric motor of 2/3-hp. size, for either 110- or 220-volt, single-phase current. The motor is provided with push-button control and over-load protection. The grinding wheel is of the cup type, 5 in. in diameter and mounted directly on the armature shaft. Grade, grain and bond of the wheel are those best suited to the work, permitting quick grinding with minimum dressing. Two-lip twist drills, with either straight or tapered shanks, may be ground to any included angle of point from 80 to 160 deg. The drill is held at three points in a check which grips the edges of the flutes as close to the cutting lips as possible. Only a quarter turn of the clamping knob is required to grip the drill firmly. This tool embodies the essential features which have been incorporated in the well-known Sellers' drill



Sellers No. 05D bench drill grinder

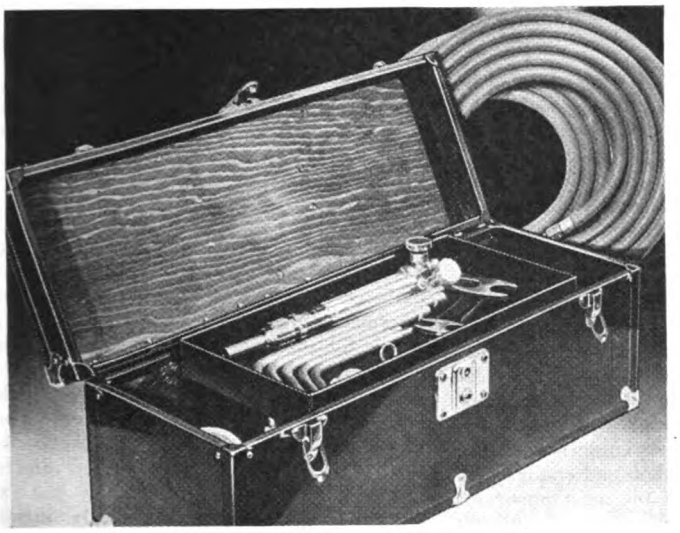
grinders of larger size and produces automatically lips of equal angle, length and clearance, with the clearance increasing properly toward the center. The operation of the machine is so simple that a skilled operator is not required. The weight is approximately 110 lb. The bench space occupied is 16 in. by 13 in. and the overall space 23 in. by 18 in.

Brazing Outfit and Oxygen Tank Valve

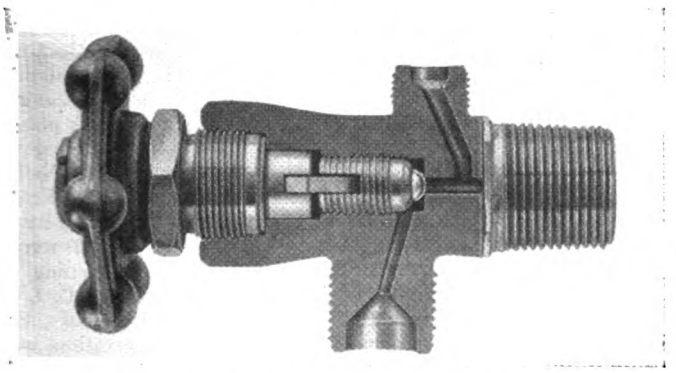
AN acetylene brazing outfit, known as "Aircobraze," has been brought out by the Air Reduction Sales Company, New York. This outfit is especially suited for use in installing Walseal treadless bronze fittings, although it is also entirely suitable for any pipe welding. With this outfit connected to the gas cylinders it is only necessary to slip the brass pipe into the Walseal fitting until it butts against the shoulder and apply the Airco-

braze process to the pipe and fitting until the white ring of Sil-Fos appears around the pipe—evidence that the joint has been made. This outfit will be distributed by the Walworth Company, Boston, Mass.

The Air Reduction Sales Company has now equipped most of its oxygen cylinders with valves having a stainless steel ball which forms the seat. The valves open and close easily, are said to possess superior sealing qualities and do not corrode or score and cause leaks. For over three years similar types of hardened stainless steel ball valves have been used on all Airco-DB welding and cutting torches. Torches so equipped have rarely required valve repairs other than the occasional renewal of valve-stem packing.



Aircobraze oxyacetylene outfit



Airco ball-seat valve for oxygen cylinders

Eliminating Hairpin Keepers

By A. Robeson

IT is generally acknowledged that the castle nut and cotter are the most effective nut-locking device as well as the simplest; and their general adoption has largely excluded the use of various nut locks, patented and otherwise. In the days when locomotive crosshead pins were lubricated from an oil cup in the main rod or on the side of the crosshead the castle nut and cotter could be used to advantage. When grease lubrication for the front end of the main rod was found more satisfactory than oil and was generally adopted the grease cavity through the center of the pin prevented the use of an ordinary castle nut and cotter, and a style of nut lock known as the hairpin keeper, Fig. 1, was introduced. This is simply a piece of ¼-in. round iron bent like a hairpin which is inserted in two holes in the pin drilled off center enough to miss the central grease cavity which is about an inch in diameter. This keeper is satisfactory, especially if the nut is slotted out to receive the keeper as shown in Fig. 2. A half-inch spring-wire cotter key and castle nut would be even more secure, and to permit the use of such a cotter on a grease-lubricated pin the arrangement shown in Fig. 3 was adopted. Instead of taking grease from an alemite fitting or grease cup on the end of the pin, the grease fitting is welded on the side of the crosshead. A hole is drilled down through the taper fit and into the pin where it connects with the grease cavity which is drilled from the back of the pin and does not extend into the threaded portion. This cavity is closed by a brass plug screwed in the back of the pin. The dowel in the pin keeps the holes lined up. Occasionally it is necessary to chip out the hole in the pin, especially after the pin has been refitted in the lathe and the shoulders set back.

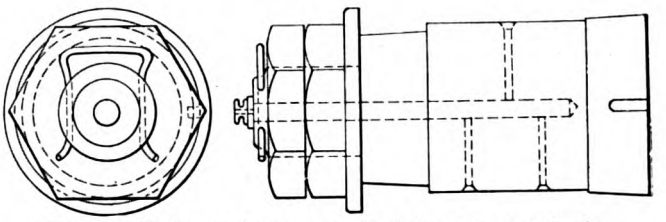


Fig. 1—Hairpin keeper applied to crosshead pin with Alemite grease fitting

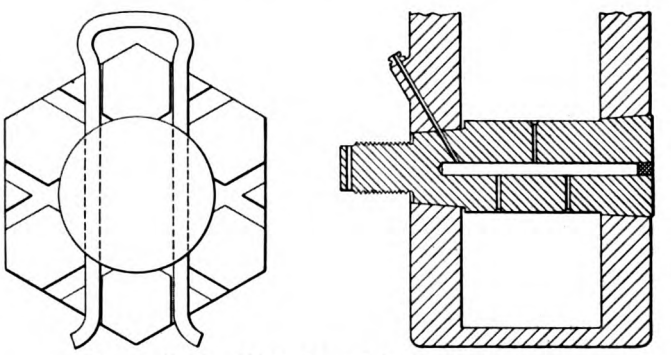


Fig. 2 (left)—Nut slotted for hairpin keeper

Fig. 3 (right)—Grease connection on crosshead permits use of ordinary castle nut and cotter

In this connection it might be mentioned that no locomotive is too old to have its lubrication modernized by installing a set of modern grease fittings that can be lubricated with a pressure gun. The old style of filling rod cups with a hand wrench passed out of the modern shop before hard times came in.

BRING 'EM BACK ALIVE.—For three days, passengers using Dearborn station in Chicago were treated to the spectacle of a monkey racing about among the rafters of the train shed, and eluding the most persistent efforts at capture. Eventually though, someone evidently experienced in the power of feminine wiles brought over a female monkey and caged her near a trap. It wasn't very long until the fugitive, listening, as so many of us have, to the call of the false siren, went in search of her and was duly caught in the trap.

Among the Clubs and Associations

RAILWAY CLUB OF PITTSBURGH.—"What of the Railroad Future?" was the subject discussed by John J. Cromwell, general counsel of the Baltimore & Ohio, before the September 27 meeting of the Railway Club of Pittsburgh.

NORTHWEST CAR MEN'S ASSOCIATION.—M. C. VanGundy, consulting chemist, Texas Company, presented a paper on the manufacture and uses of petroleum products at the October 1 meeting of the Northwest Car Men's Association.

CANADIAN RAILWAY CLUB.—W. H. Stevenson, locomotive foreman, Canadian Pacific, will present a paper entitled "A Night with the Locomotive Foreman" at the meeting of the Canadian Railway Club which will be held at 8 p. m. on October 8 at the Windsor Hotel, Montreal, Que.

TORONTO RAILWAY CLUB.—The Diesel Engine, Its History, Developments and Application, particularly in the transportation field, will be discussed by J. L. Bushfield, president of J. L. Bushfield & Co., Ltd., before the meeting of the Toronto Railway Club to be held on the evening of October 5 at the Royal York Hotel, Toronto, Ont.

NEW YORK RAILROAD CLUB.—The 1934-35 season of the New York Railroad Club will begin on the evening of October 19 at the Auditorium of the Engineering Societies Building, 29 West Thirty-Ninth street, New York, when a paper on "What Motive Power for High Speeds?", by G. I. Wright, chief electrical engineer, and P. A. McGee, assistant engineer, of the Reading, will be presented. The paper will be a study of main-line and suburban passenger trains, evaluating the effects of train shape, size and weight on the cost of power with steam, electric and oil-electric motive power at speeds up to 125 m.p.h. It will develop power requirements and estimated costs of operation for all lengths of trains and for a wide range of speed and give cost comparisons of conventional and light-weight trains of the lengths considered. ¶ The members of the Metropolitan Section of the American Society of Mechanical Engineers and the members of the American Institute of Electrical Engineers have been invited to participate in this meeting.

GENERAL FOREMEN'S ASSOCIATION.—After a lapse of four years a meeting of the International Railway General Foremen's Association was held at the Hotel Sherman, Chicago, September 17 and 18, with President A. H. Keys, district master car builder, B. & O., presiding, and Secretary-Treasurer William Hall in charge of the general arrangements. The principal address was made by C. M. Darden, superintendent machinery, N. C. & St. L., who stressed the importance of railway shop supervisors in maintaining equipment in proper condition to sustain modern, high operating speeds and severe service conditions. Mr. Darden also emphasized the need for the maintenance of high standards of workmanship and at the same time keeping shop costs low, these two somewhat conflicting requirements being kept in the proper balance by the good judgment of shop superintendents, master mechanics, general foremen, enginehouse foremen and, in fact, all shop and enginehouse supervisors. ¶ One of the most important of the reports was that on "Minimizing Federal Defects," presented by Chairman C. M. Hillman, general foreman, M. & St. L. Another committee report on a subject of considerable present interest was entitled "Maintenance of Gas-Electric Equipment," prepared by a committee headed by Chairman M. A. Slack, general foreman, N. Y., N. H. & H.

MECHANICAL SUPERVISORS' CONVENTIONS 1935.—At a meeting of representatives of the various mechanical supervisors' associations, held September 18, at the Hotel Sherman, Chicago, it was tentatively agreed to held the next full-membership meetings of these associations at the same time and place so that a single exhibit of railway equipment and supplies will serve equally well for all of the associations. The selection of a central location will also contribute to economy in travel and thus facilitate resuming the annual conventions, which, in some cases, have been discontinued for a period of four years. ¶ Tentative plans have, therefore, been made to hold the next annual meetings of these associations in two groups, early in May, 1935, at the Hotel Sherman, Chicago. The first group, including the Traveling Engineers' Association, Air Brake Association, International Railway General Foremen's Association and the Car Department Officers' Association, will hold individual but simultaneous meetings on Thursday, Friday and Saturday, May 2 to 4, inclusive. The second group, including the International Railway Fuel Association, Master Boiler Makers' Association, American Railway Tool Foremen's Association and International Railway Master Blacksmiths' Association, will meet on Monday, Tuesday and Wednesday of the following week. Recommendations from these associations will thus be available in time for consideration at the meeting of the American Railway Association, Mechanical Division, which it is planned to hold at Atlantic City, N. J., in June, if business conditions permit. ¶ The exhibit in connection with the 1935 meetings of the mechanical supervisors' associations at Chicago will be provided by the Allied Supply Association.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—In the first annual meeting since May, 1930, over 180 members and guests gathered for a two-day session at the Hotel Sherman, Chicago, September 17 and 18. While the program was shorter than usual and there was no accompanying exhibition of railway equipment and supplies, the meeting was a pronounced success from the point of view of general importance of the subjects discussed and the keen interest in these subjects as evidenced by the extensive discussion. An unusually important action was taken at the close of the meeting when seven specific items bearing on the attainment of maximum fuel returns per dollar expended were suggested for the development of recommended practices by the American Railway Association, Mechanical Division. The present officers were re-elected and will hold office until the next annual meeting which it is planned to have in May, 1935. ¶ The meeting was presided over by President J. M. Nicholson, master mechanic, A. T. & S. F., Argentine, Kans., the general program having been developed by Secretary-Treasurer T. Duff Smith. Following an opening address by President Nicholson, R. L. Lockwood, director, Section of Purchases, Federal Co-ordinator of Transportation, made an address in which he paid tribute to the constructive character of the association's activities in the past and expressed his desire to help co-ordinate the activities of the railroads in securing improved fuel purchasing methods. Carroll B. Huntress, president, Appalachian Coals, who addressed the association as a representative of the coal industry, said that the railroads should co-operate more fully with the producers, as, for example, in the use of screenings on stoker-fired locomotives, and other sizes of coal not in urgent commercial demand. Lawrence Richardson, mechanical assistant, B. & M., discussed the subject of locomotive performance, stating that it is not possible to reproduce in actual practice results obtained when using a dynamometer car, unless engine crews are given the necessary indicating and recording equipment to show them when the most efficient operation is being secured. Committee reports were presented on the following subjects: Fuel Distribution and Statistics; Storage, Oil and Coal; Front Ends, Grates and Ash Pans; Locomotive Firing Practice, Oil and Coal; Fuel Stations; New Locomotive Economy Devices; Stationary Boilers; Steam Turbine and Steam Condensing Locomotives and Inspection and Preparation of Coal.

NEWS



THE CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC is making plans for the construction of a sandblast building at its locomotive and car shops at Milwaukee, Wis.

THE SOUTHERN RAILWAY will retire from service and scrap 4,973 units of equipment, consisting of 112 locomotives, 40 passenger train cars, 4,492 freight train cars, and 329 units of work equipment. The company is now negotiating a contract for the sale of the scrap steel.

THE CAMBRIA & INDIANA is asking for bids on changing 1,000 of its cars from arch bar trucks to cast steel side frames, on the basis of applying suitable second-hand cast steel side frames and truck bolsters if such are available and if they will meet the specifications of the A.R.A.

Code Authority Approved

THE National Recovery Administration has announced its approval of the method of selecting the personnel of the Code authority for the locomotive appliance industry as follows: M. Schiller, vice-president, the Superheater Company, New York City; Henry Jude, assistant sales manager, Consolidated Ashcroft-Hancock Company, Inc., New York City; Elliott Curtiss, president, U. S. Metallic Packing Company, Philadelphia, Pa., and G. W. Alcock, assistant secretary, Lima Locomotive Works, Inc., New York City.

I. C. Crafts Vote on Unions

IN a referendum conducted by the National Mediation Board, shop employees of the Illinois Central on August 30 chose to be represented by the standard unions instead of company unions. Machinists, boiler-makers, blacksmiths, sheet metal workers, electrical workers, carmen, firemen, oilers and coach cleaners were involved. This referendum under which employees choose between company and outside unions is the first large one conducted by the mediation board since its appointment. Requests for similar referenda among employees of other large carriers are being prepared by the American Federation of Labor. In the I.C. election 9,000 employees were eligible to vote and approximately 90 per cent availed themselves of the privilege.

Chinese Railways Want Second-Hand Equipment

SECRETARY ROPER of the Department of Commerce has made public a letter from James Harvey Rogers, who has been in China for some time making studies for the United States government in connection with the monetary situation, stating that he had been asked by Chinese railway officers to call attention in this country to the great demand in China for second-hand railroad equipment. Such equipment is desired on a credit basis, to be paid for out of earnings, but there has been a suggestion of a possibility of financing it through the Export and Import Bank.

Trade Practice Complaints Committee for Car Appliance Industry

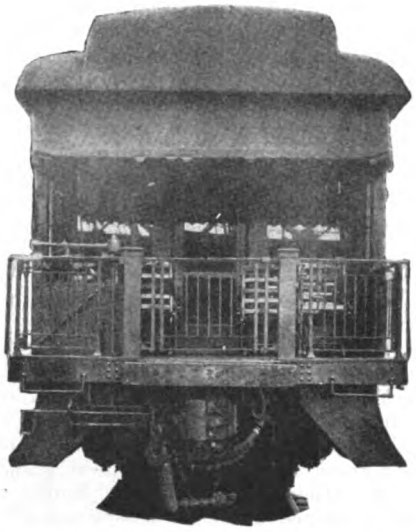
THE National Recovery Administration has approved a plan of organization and precedure for the trade practice complaints committee of the railway car appliances industry, a division of the fabricated metal products and manufacturing and metal finishing and metal coating industry. The members of the committee now authorized to proceed with the adjustment of trade practices are: S. L. Beymer, treasurer of the Hutchins Car Roofing Company, Detroit, Mich.; G. N. DeGuire, president of the Ajax Hand Brake Company, New York; C. D. Jenks, president of the Chicago-Cleveland Roofing Company, Chicago; and A. C. Moore, president of the Chicago Railway Equipment Company, Chicago.

Shopcrafts Hold Meeting

THE first annual convention of the Brotherhood of Railroad Shopcrafts of America which came into existence on July 6, following a two-day meeting at Chicago called by the Allied Independent Railroad Labor Organizations of Western Lines, was held in that city on September 4-6. The organization, which is opposed to affiliation with the American Federation of Labor, elected the following officers: President, H. G. Kinney, of the Southern Pacific, Sacramento, Cal.; vice-president, Walter Franklin, New York; national organizer, Theodore Davis of the Pennsylvania, New York; and secretary-treasurer, J. I. McConnel, of Topeka, Kan. They chose St. Louis, Mo., as the place for the next convention.

Equipment Improvement Programs

THE ILLINOIS CENTRAL has embarked on an extensive program of improvement of its passenger equipment, which includes the extensive repair, rebuilding and modernizing of 162 steel cars, including 30 mail, 27 baggage, 11 baggage-smoker, 37 coach, 22 compartment-coach, 9 chair, 13 dining, 6 club, 5 parlor-lounge, and 2 cafe-lounge



cars. In addition, 24 steel underframe coaches and head-end cars will be repaired. This work, to be done by company forces at Burnside shops, Chicago, is now well under way and 73 cars have already been completed and returned to service. Air-conditioning equipment will be installed in all of the 24 diners, club and parlor-lounge cars. Of the 162 all-steel cars to be reconditioned, approximately 100 will be repaired in kind and the remainder will be practically rebuilt, re-decorated and re-equipped, making them the equivalent of new cars, in so far as modern conveniences are concerned.

The Baltimore & Ohio program to cost $4,279,244, which included the reconditioning of 240 locomotives, making heavy repairs to 4,800 freight cars and reconstructing 200 automobile cars, as announced in the April issue of the *Railway Mechanical Engineer*, has been modified and now calls for repairs to 100 additional locomotives at an estimated cost of $4,500 each and repairs to approximately 7,000 freight cars at an estimated cost of $150 a car. Work has already been completed on the 240 locomotives at a cost of $1,077,863. 200 automobile cars at a cost of $128,145 and 732 of the 4,800 freight cars at a cost of $309,603—a total cost, advanced by the Government, of $1,515,611, leaving a balance of $1,484,389 to be advanced on account of the repairs to 4,068 freight cars. The road now proposes to use the unexpended balance allotted for repairs to the 4,800 freight cars in repairing an additional 100 locomotives and approximately 7,000 freight cars. The proposed changes have been accepted by the Federal Emergency Administrator of Public Works and have been approved by the Interstate Commerce Commission.

Plan for Purchasing Board Dropped After Experiment

EXPERIMENTS with the plan proposed by the Federal Co-ordinator of Transportation to establish reviewing boards of purchasing officers to receive and study orders placed by railroads on manufacturers for materials have been concluded after six Chicago railroads submitted copies of their orders daily for a two months' period, and the plan has been abandoned, according to information issued by the

Purchases and Stores division of the American Railway Association to its members. In order to provide a direct means for the Director, Section of Purchases, Federal Co-ordinator, to obtain information desired on subjects of a general nature, which do not come under the scope of work considered by the regular subject committees of the division, it has been decided that the group meetings of purchasing officers will be extended and established in all territories under the direction of the division in place of the original reviewing board plan, the report states. It is felt that through this method better results will be secured in promoting uniformity in practice and the adoption of standards.

The various groups and the chairmen of each group are as follows: Eastern group, A. W. Munster, vice-president, Boston & Maine, Boston, Mass.; Southern group, J. L. Bennett, purchasing agent, Central of Georgia, Savannah, Ga.; Western group, D. C. Curtis, chief purchasing officer, Chicago, Milwaukee, St. Paul & Pacific, Chicago; Northwestern group, C. C. Kyle, purchasing agent, Northern Pacific, St. Paul, Minn.; Southwestern group, J. H. Lauderdale, general purchasing agent, Missouri Pacific Lines, St. Louis, Mo.; Far Western group, U. K. Hall, general purchasing agent, Union Pacific system, Omaha, Neb. The chairman of the division will be chairman ex-officio of all groups.

A special purchasing group advisory committee has also been selected to formulate uniform plans and policies to be followed by the several purchasing groups, the committee consisting of: F. D. Reed (chairman), purchasing agent, Chicago, Rock Island & Pacific; M. J. Collins, general purchasing agent, Atchison, Topeka & Santa Fe; A. C. Mann, vice-president, Illinois Central; and C. E. Walsh, general purchasing agent, Pennsylvania.

Meetings of the Western group were held in Chicago on July 11 and August 14, while the Eastern group held a meeting in Boston on July 18 and the Southern group held a meeting at Atlanta, Ga., on July 19. R. L. Lockwood, Director, Section of Purchases, Federal Co-ordinator, attended the Boston meeting, and H. P. Dalzell, of the Section of Purchases of the Federal Co-ordinator, attended the meeting at Atlanta. Steel prices, coal prices, the construction code and sales were considered at Chicago, while subjects considered by the Eastern group included the purchase and sale of surplus and second-hand material, the sale of obsolete equipment and rail, the simplified invoice form, interest on invoices under the steel code, the use of A. R. A. and A. R. E. A. lumber specifications, bituminous coal, contracts, discount allowances to governmental purchasing agencies and description and specifications in purchasing orders. The codes for construction, bolts, nuts and rivets, lumber, cross ties, steel castings and envelopes were discussed at Atlanta; also oxyacetylene rentals, material stores expenses, coal prices and the commercial clauses of the iron and steel code.

More Than Half of P.W. A. Railroad Loans Paid Out

More than half of the $190,950,500 allotted by the Public Works Administration as employment-creating loans to 31 railroad companies has been paid out and on July 15, the latest date for which complete figures are available, 70,060 men were directly employed as a result of these loans, with probably a considerably greater number of men and women indirectly employed. Payments on loans totalled $95,904,000. This was the report made to Public Works Administrator Harold L. Ickes by Frank C. Wright, director of the Division of Transportation Loans.

Itemizing the direct employment created by the P.W.A. program of loans, Mr. Wright reported:

(1) That 20,533 railway shopmen were employed in the shops of 14 roads to which P.W.A. made loans totalling $51,905,043 for repairing and rebuilding old cars and locomotives and building new ones in their own shops.

(2) That 35,902 track men and other classes of outside railway employees were working on right of way improvements being made by 19 railroads as a result of $77,075,957 of loans made by P.W.A. to finance those improvements.

(3) That 13,625 men were employed in the shops of locomotive and car-building companies which have received orders for new cars and locomotives as a result of P.W.A. loans totalling $61,969,500 to 18 railroad companies for purchase of new equipment.

The indirect and industrial employment created by the placing of orders for approximately $100,000,000 worth of materials cannot be accurately stated. Among the railroads reporting the largest number of shopmen at work were the Southern Pacific, with 5,926 men employed in its shops and roundhouses; the Pennsylvania, with 3,447 men; the Illinois Central, with 4,187 men; and the Great Northern with 2,289 men.

The stimulus that the P.W.A. loans for purchase of new equipment has given to the long dormant car and locomotive building industries is indicated by the fact that out of 19,272 men employed in the shops where P.W.A. financed equipment is being assembled 13,625 were employed on that equipment.

P.W.A. Loans to Railroad Companies and Payments Made

Railroad	Loans Allotted	Amount Paid Out
Baltimore & Ohio	$6,400,000	$3,000,000
Boston & Maine	7,318,000	3,017,000
Central of Georgia	120,000	109,000
Chesapeake & Ohio	16,876,000	8,762,000
Chicago & Eastern Illinois	240,000	240,000
Chicago & North Western	1,400,000	1,400,000
Chicago Great Western	1,200,000	.....
Chicago, Milwaukee, St. Paul & Pacific	4,033,000	3,617,000
Delaware, Lackawanna & Western	4,666,000	178,000
Erie	13,953,000	9,692,000
Grand Trunk Western	250,000	250,000
Great Northern	5,785,000	3,040,000
Gulf, Mobile & Northern	1,216,000	340,000
Illinois Central	12,000,000	8,000,000
Interstate	250,000	210,000
Kansas, Oklahoma & Gulf	255,000	255,000
Lehigh Valley	2,600,000	2,000,000
Lehigh & New England	1,212,000	1,212,000
Maine Central	313,000	313,000
Midland Continental	36,000	.....
Missouri Southern	32,500	.....
New York Central	2,500,000	2,500,000
New York, Chicago & St. Louis	5,028,000	4,030,000
New York, New Haven & Hartford	7,100,000	2,525,000
New York, Ontario & Western	235,000	235,000
Northern Pacific	1,220,000	.....
Pennsylvania	80,650,000	33,604,000
Pittsburg & West Virginia	331,000	.....
Savannah & Atlanta	250,000	.....
Southern Pacific	12,000,000	6,080,000
Wabash	1,481,000	1,295,000
	$190,950,500	$95,904,000
Balance of blanket allotment of $41,000,000 for rail purchases remaining unallocated	8,657,300	
Total amount allotted for R.R. loans	$199,607,800	

[The Public Works Administration has since announced that the number of railroad employees working in shops and rights of way on the construction and rehabilitation program financed by P.W.A. dropped from 61,500 on July 14 to 57,000 on August 25. The Bureau of Labor Statistics of the Department of Labor reported 13,625 at work on July 14 on new cars and locomotives being built in outside shops as a result of P.W.A. loans to railroad companies, and it is estimated that this number had increased to 16,000 by August 25, although reports of the actual number of men at work in their shops have not been received from the manufacturers.]

The accompanying table shows the amounts allotted in loans to individual roads for all purposes, and the amount paid out to each up to July 15. Since that date an additional allotment of $3,000,000 has been made to the Lehigh Valley for rebuilding 1,500 box cars and buying 300 50-ft. gondola cars of 70 tons' capacity and 100 65-ft. gondola cars of 70 tons' capacity, also three new Diesel-electric locomotives.

This is the third P.W.A. loan to the Lehigh Valley. The first, of $2,000,000, was made last winter for repairing and rebuilding 2,000 freight cars. The second,

New Equipment

Car Orders

Road	No. of cars	Type of car	Builder
Bethlehem Steel Co.	8[1]	70-ton air dump	Magor Car Corp.
Gray Chemical Co.	2	8000-gal. aluminum tank	General American Trans. Corp.

Locomotive Orders

Road	No. of locos.	Type of locomotive	Builder
Missouri-Southern	1[2]	Diesel-electric	Plymouth Loco. Wks.[3]

Locomotive Inquiries

Chilean State Rys.	10	4-8-4	.....
Pennsylvania	50 or 60	Electric	.....

[1] For service in Chile.
[2] This locomotive, for which a P.W.A. contract has been signed, will be a 70-ton, 500-hp., double-unit for combination road and switching service. Delivery will be made about November 15.
[3] Division of the Fate-Root-Heath Company, Plymouth, Ohio.



Only a few years ago, locomotive materials were confined to plain carbon steel, wrought and cast iron. « « « But the modern locomotive, with its higher pressures, increased speeds and greater loads, now has a wide variety of alloy steels to draw upon, many of them developed by Republic metallurgists for the specific set of conditions they must meet. « « « Today, higher boiler pressures have brought the Agathon steel boiler shell and the Agathon Alloy steel staybolt. « « « Fireboxes are built of long-life, corrosion-resisting Toncan Iron; pins and bushings of Agathon Nickel Iron; still other special alloy steels go into rods, motion work and axles. « « « Modern locomotives have their counterpart in modern materials. You wouldn't build a locomotive that is obsolete in design. Don't build one of obsolete materials. Consult with Republic metallurgists on the steels that best suit each condition of railroad service.

Toncan Iron Boiler Tubes Pipe Plates Culverts Rivets Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel . . . The Birdsboro Steel Foundry & Machine Company of Birdsboro, Pa. has manufactured and is prepared to supply under license, Toncan Copper Molybdenum Iron castings for locomotives

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

AGATHON STEELS

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES YOUNGSTOWN, OHIO
Reg. U. S. Pat. Off.

TONCAN COPPER MOLYBDENUM IRON

of $600,000, was to enable the company to purchase five new locomotives, which are being manufactured by the Baldwin Locomotive Works.

Administrator Ickes has also signed a contract for a loan of $32,500 to the Missouri Southern, the money to be used to purchase a new Diesel-electric locomotive which is being built by the Plymouth Locomotive Works. The allotment for this loan was made some time ago.

Two previously awarded railroad loan allotments have been rescinded at the request of the respective roads—one of $3,500,000 to the Escanaba, Iron Mountain & Western for construction of a concrete ore dock at Escanaba, Mich., and one of $75,000 to the Fort Smith & Western for repairs to roadway and equipment.

The Erie has been authorized to use $680,000 of its $11,282,000 allotment for equipment purchases to buy a new ferry boat for use between New York City and New Jersey. When the $11,282,000 allotment was made last winter it was expected that the 3,775 freight and 133 passenger cars to be purchased by the Erie would cost that amount. All of this equipment now is under contract and in process of construction and will cost $10,602,000. The Erie, therefore, has been authorized to use the $680,000 balance to create additional employment through the construction of the ferry boat.

Supply Trade Notes

LON R. SMITH has been appointed assistant sales manager and Charles Dahlquist and G. C. Rasey, representatives of the Hercules Motor Corporation, Canton, Ohio.

THE CHICAGO PNEUMATIC TOOL COMPANY'S Birmingham, Ala., office has been moved from 1829 South Second Avenue to 211 South Twentieth street. W. S. Lynch is manager of the Birmingham district office.

ARTHUR H. SMITH, special representative of railroad sales in the East for the Youngstown Sheet & Tube Company, has resigned to become associated with the Kerite Insulated Wire & Cable Company, Inc., in its railway sales department, with headquarters at New York.

CONSOLIDATION of the Republic Steel Corporation, Youngstown, Ohio, and the Corrigan, McKinney Steel Company, Cleveland, Ohio, was approved at meetings of the boards of directors of both companies on August 27, subject to ratification by the stockholders.

THE HAUCK MANUFACTURING COMPANY, Brooklyn, N. Y., has purchased the assets and good will of the oil burner division of the Mead-Morrison Manufacturing Company, East Boston, Mass., and will continue the manufacture of, and to stock spare parts for, rivet forges and portable torches produced heretofore by the latter company.

THE BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa., has assumed all sales and engineering of the products of its subsidiary, The Whitcomb Locomotive Company, Rochelle, Ill., and has established an internal combustion locomotive section of its sales department, in charge of H. H. Perry as manager, assisted by H. V. Huleguard. Mr. Perry was previously vice-president and general manager, and Mr. Huleguard, sales manager of The Whitcomb Locomotive Company. The new section will handle all sales of Baldwin and Whitcomb internal combustion locomotives of all sizes, and sales of electric locomotives except to public service railroads. Whitcomb domestic sales agents will continue to sell in the name of Whitcomb, and the Whitcomb plant will continue the manufacture of Whitcomb products at Rochelle, in charge of Thomas H. Mars as superintendent. Orders for repair parts, and the servicing of Whitcomb products in the field, will be handled at Rochelle by L. W. Wrenn as Baldwin sales correspondent.

JOHN C. DILWORTH, for many years associated with the Dilworth Porter Company, Pittsburgh, Pa., has severed his association with that company and has joined the sales force of the Carnegie Steel Company, as manager of railway sales with headquarters at Pittsburgh. Mr. Dilworth will handle for the Carnegie Steel Company all railway specialties and supplies, a line with which he has been in close touch throughout his industrial career. He was graduated in 1905 from Sheffield Scientific School of Yale University, and also attended Shadyside Academy in Pittsburgh and St. Paul's Preparatory school. Mr. Dilworth went with the Dilworth Porter Company immediately after his graduation from Yale and for years was in the operating department of the industry, later taking up the sales end.



John C. Dilworth

WILBUR H. WINTERS has been elected vice-president in charge of operations of the American Brake Shoe & Foundry Company, with headquarters at New York. After five years on fortification construction work on the Panama Canal, Mr. Winters entered the employ of the American Brake Shoe & Foundry Company in 1916. In 1921 he was appointed assistant controller and in 1924 was transferred to the operating department as general superintendent of foundries. Mr. Winters has been active in the preparation of the Gray Iron Foundry Code, being a member of the Gray Iron Code Authority and a director of the Gray Iron Foundry Society.

C. V. KENT, secretary and treasurer of the Badeker Manufacturing Company, Chicago, has been elected president to succeed Alfred N. Willsie, deceased.

H. S. MCPHERSON, in charge of mechanical sales in the Boston (Mass.), district for the Mechanical Goods division of United States Rubber Products, Inc., New York, has been appointed manager of mechanical sales in the St. Louis (Mo.), district. Mr. McPherson has been with this company for over 15 years and prior to his Boston service held positions in the export department in Australia, South America, and the Far East. W. G. Mueller, salesman with the company for more than 25 years chiefly in the Connecticut territory, has been promoted to manager of mechanical sales, Boston branch.

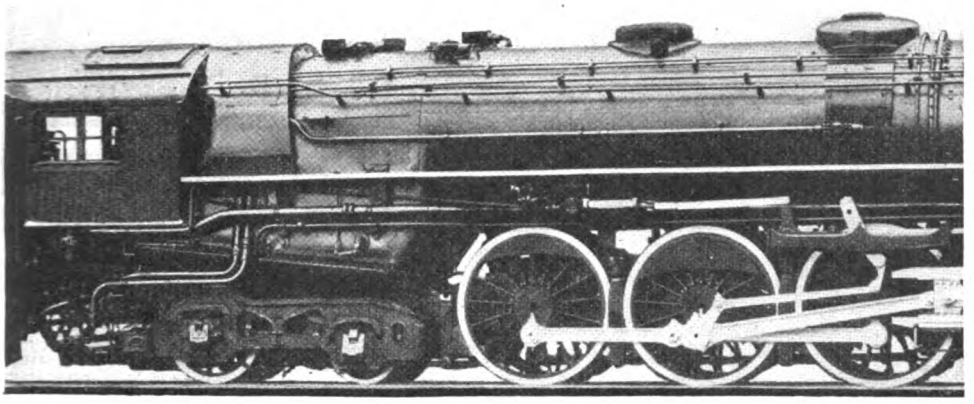
Obituary

R. J. HIMMELRIGHT, vice-president of the General Refractories Company, New York, died on August 30 in a hospital at Perth, Ontario. Mr. Himmelright was born at Wadsworth, Ohio, 51 years ago and was graduated in 1908 from Purdue University with the degree of mechanical engineer. While at Purdue he specialized in railroad work and following his graduation entered the service of the Lake Shore & Michigan Southern as a special apprentice. He then entered the service of the Locomotive Stoker Company as mechanical expert. In 1913 he became a traveling engineer in the employ of the American Arch Company and subsequently served successively as assistant to the manager of the service department and manager of that department until March, 1918, when he was elected vice-president in charge of the service and road development work in the United States and Canada. Mr. Himmel-

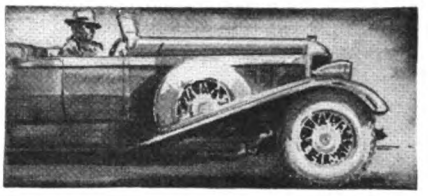


R. J. Himmelright

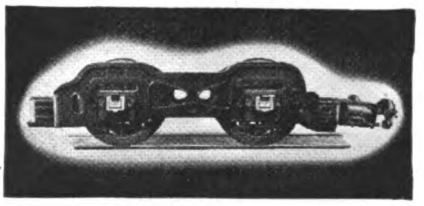
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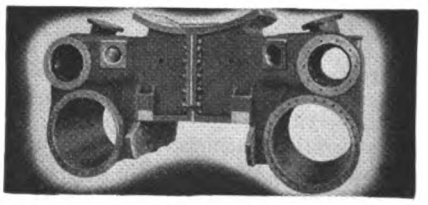
The *Double* Power Locomotive



If you could shift your locomotive into low at starting, the way you do your car, you could reduce the size of cylinders and save a lot of locomotive weight



and maintenance. • In effect the Booster does this. It provides the extra "pull" in starting that permits use of smaller cylinders. • Smaller cylinders naturally mean



lower maintenance due to a reduction in the amount of work done. • This saving in itself is more than enough to justify application of The Locomotive Booster. • Build better, not bigger locomotives.

Booster repair parts made by the jigs and fixtures that produced the original are your best guarantee of satisfactory performance.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

right left the service of the American Arch Company in 1927 and was one of the founders of the railroad department of the General Refractories Company, having served since that time as vice-president of that company. He also represented, as manufacturers' agent in the Eastern part of the United States, the Wilson Engineering Corporation, the Illinois Railway Equipment Company, the Standard Car Truck Company and the Graham-White Sander Corporation. He had for many years taken an active part in the affairs of the June conventions at Atlantic City, N. J., having served as a member of the executive committee of the Railway Supply Manufacturers' Association, and was a member of a number of clubs affiliated with the railroad interests.

ALFRED N. WILLSIE, president of the Badeker Manufacturing Company, Chicago, died in that city on August 16.

ANDREW C. WOODS, Chicago representative of the Union Spring & Manufacturing Company, Pittsburgh, Pa., died on August 24.

JOHN A. TOPPING, formerly from 1906 to 1930 chairman of the Republic Iron & Steel Company, died in his home at Greenwich, Conn., on August 24, at the age of 74.

Personal Mention

General

S. M. SADLE, a locomotive engineer on the Chicago, Burlington & Quincy, has been appointed to the newly-created position of system fuel supervisor, with headquarters at Chicago.

Master Mechanics and Road Foreman

W. L. BOGGS has been appointed road foreman of engines of the Erie, with headquarters at Meadville, Pa., succeeding F. M. Steele, retired.

A. R. MANDERSON has been appointed assistant master mechanic of the Delaware, Lackawanna & Western, with headquarters at Buffalo, N. Y.

M. A. QUINN, master mechanic of the Delaware, Lackawanna & Western at Binghamton, N. Y., has been appointed master mechanic, with headquarters at Buffalo, N. Y., the motive power and equipment departments of the Buffalo and Syracuse and Utica divisions of the Lackawanna having been consolidated.

Car Department

R. E. MAUCK, car foreman of the Union Pacific at Kansas City, Kans., has been promoted to the position of repair track foreman, with headquarters at Denver, Colo.

W. A. COOLING, repair track foreman of the Union Pacific, has been appointed general car foreman, with headquarters at Denver, Colo., succeeding P. J. McNamara, retired.

Purchasing and Stores

R. D. LONG, general storekeeper of the Chicago, Burlington & Quincy, with headquarters at Chicago, has had his jurisdiction extended to include the reclamation and scrap dock at Eola, Ill., the concrete plant at Montgomery, Ill., and the tie and timber preservation plants at Galesburg, Ill., and Sheridan, Wyo.

Obituary

MELVIN R. COUTANT, former master mechanic for the Ulster & Delaware at Kingston, N. Y., died at his home in that city on August 15, after a brief illness. Mr. Coutant had been in the service of the Ulster & Delaware for approximately 30 years, having retired from the position of master mechanic when the road was taken over by the New York Central.

GRANT HALL, vice-president of the Canadian Pacific, died on August 29 at the age of 71. Mr. Hall had been taken to a hospital a few weeks ago after suffering a stroke. He was born in November, 1863,



Grant Hall

at Montreal, Que., and attended Bishops College and School, Nennoxville, Que. He entered the service of the Grand Trunk in 1883 as apprentice machinist at the Point St. Charles shops, Montreal. In 1887 he became locomotive foreman for the Canadian Pacific and in 1893, general locomotive foreman for the Inter-colonial at Moncton, N. B. In September, 1898, he returned to the Canadian Pacific where he served consecutively as general foreman, first at the McAdam and later at the Winnipeg shops; master mechanic of the British Columbia division; assistant superintendent of motive power, eastern lines, and superintendent of motive power and car department, western lines. In November, 1911, he became assistant general manager of the western lines, and in January, 1913, was appointed general manager of the same lines. Mr. Hall became vice-president of the C. P. R. in October, 1918. He was also president of the Dominion Atlantic, the Quebec Central and the Algoma Eastern.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

ALUMINUM PAINT.—Aluminum paint—its uses and application in a wide diversity of fields, including the railroad—is discussed in a 62-page booklet issued by the Aluminum Company of America, Pittsburgh, Pa.

PIPE THREADING AND CUTTING MACHINE—The Landis Machine Company, Waynesboro, Pa., gives in folder form information concerning the "Little Landis" pipe threading and cutting machine for jobbing and maintenance threading.

BEARING BRONZE.—The Aluminum Industries, Inc., Cincinnati, Ohio, has issued a bulletin in which Permite leaded phosphor bronze bars for lathe or screw-machine production are discussed. These bars are available in all standard bearing alloys and in 6-ft. or shorter lengths; diameters, $\frac{5}{8}$ in. to 2 in. by $\frac{1}{16}$-in. steps.

HARNISCHFEGER ANNIVERSARY.—A review of its past achievements and some rededication of its facilities to the future are presented in an attractive booklet of 84 pages issued by the Harnischfeger Corporation, Milwaukee, Wis., in commemoration of its fiftieth anniversary.

PRESSURE REGULATORS AND REGULATION PROBLEMS.—"Oxyacetylene Welding and Cutting Pressure Regulators and Regulation Problems" is the title of the new 16-page booklet of the Air Reduction Sales Company, 60 East Forty-Second Street, New York, which contains a study of the various standard types of regulators and of the difficulties and problems which led to the development of the new Airco types, several of which are shown in cross section.

USS HIGH-TENSILE STEELS.—Two interesting booklets on the characteristics and uses of USS Cor-Ten, USS Man-Ten and USS Sil-Ten have been issued by the United States Steel Corporation. The first of these high tensile steels for light-weight construction is a low chromium copper silicon steel; the second a medium manganese steel, and the third a strong structural silicon steel. The names selected to designate these steels are partially indicative of either the individual characteristic or the predominating chemical element; For example, "Cor" denotes high corrosion resistance; "Man," manganese; "Sil," silicon, and "Ten," high tensile strength. These booklets can be obtained from any subsidiary company of the United States Steel Corporation.

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

November, 1934

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices,
30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: Terminal Tower
Washington: 832 National Press Bldg.
San Francisco: 58 Main St.

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Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States and possessions: 1 year, $3; 2 years, $5. Canada, including duty: 1 year, $3.50; 2 years, $6. Foreign countries: 1 year, $4; 2 years, $7.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.

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Railway
Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

November - 1934

Nickel Plate Installs 15 2-8-4 Type Fast-Freight Locomotives

Another road adopts this modern type for accelerating its freight movements

THE New York, Chicago & St. Louis is now receiving delivery of the first of 15 fast freight locomotives of the 2-8-4 type built by the American Locomotive Company. These engines, which are the first of this type to be placed in service by the Nickel Plate, are typical modern freight locomotives of what in the last few years has come to be recognized as good current practice. While of conventional design in so far as general appearance is concerned, they embody those details of design and proportions which are essential for the economical and expeditious handling of freight traffic in a relatively level territory.

The boiler is of generous capacity as it is now generally recognized that high sustained horsepower at speeds is dependent almost entirely on boiler capacity. The size of the cylinders, 25 in. by 34 in. with 69-in. drivers, is different from any previous locomotives of the 2-8-4 type. The rated tractive force with the 245 lb. boiler pressure is 64,100 lb.

As many detail parts of these new engines as possible are interchangeable with similar parts of the Chesapeake & Ohio 2-10-4 type locomotives. It will be recalled that 40 locomotives of this type were built for the C. & O. in 1930 by the Lima Locomotive Works, Inc., and that a full description was given in the *Railway Mechanical Engineer,* November, 1930.

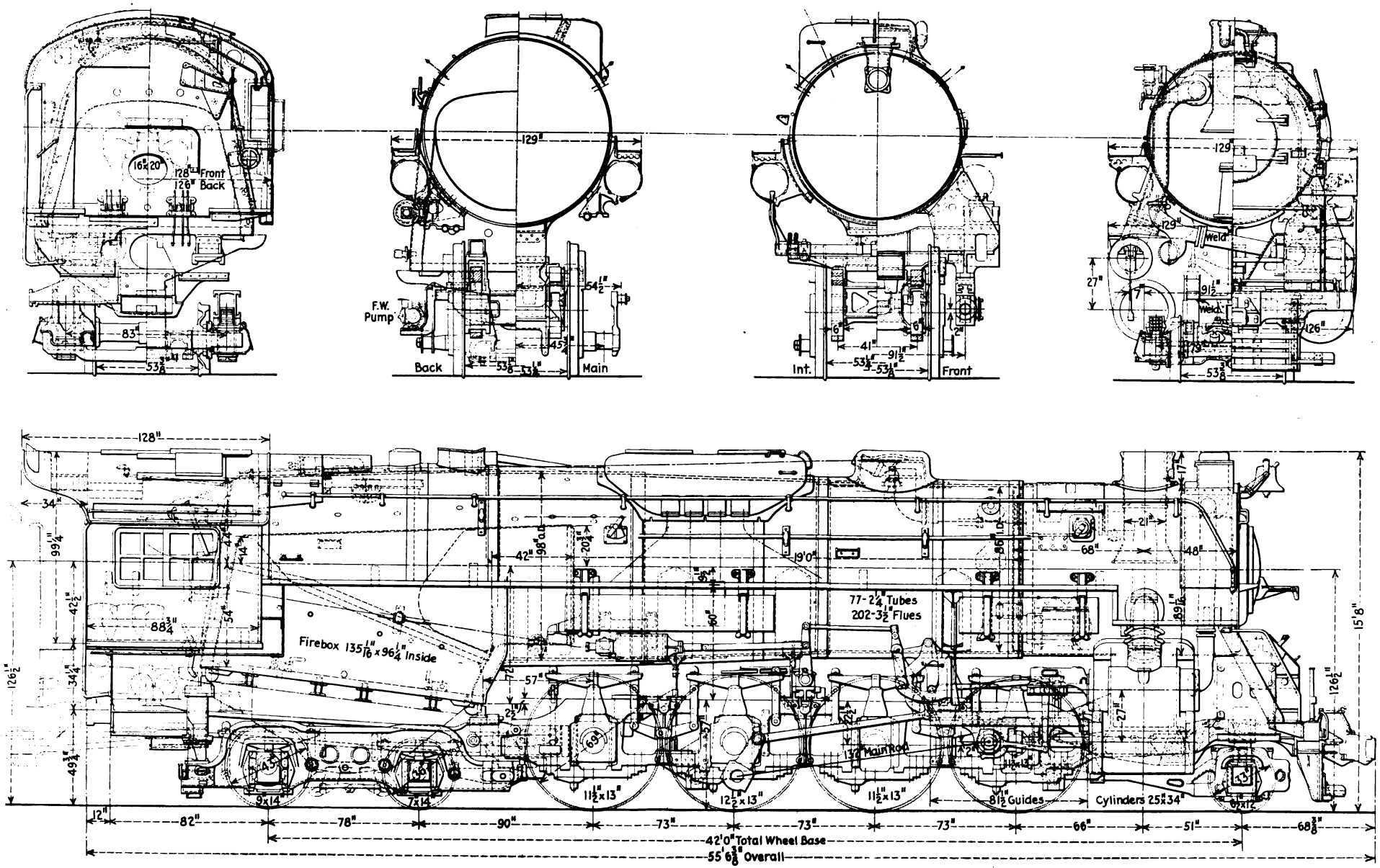
The 2-8-4 type was first introduced in 1925, and for new power has taken the place of the long popular 2-8-2 type just as some thirty years ago the Mikado type superseded the 2-8-0 or Consolidation type for freight traffic other than slow drag freight. Each step forward has been marked by larger wheels for increased running speeds and larger boilers required for sustained horsepower at high speeds as well as improvements for increased efficiency.

Including the Nickel Plate there are now 298 locomotives of this type on nine roads. This includes the following: 55 on the Boston & Albany[1], built by the Lima Locomotive Works in 1925, which weigh 389,000 lb., have 28-in. by 30-in. cylinders, 63-in. drivers, 240 lb. boiler pressure, rated tractive force 69,400 lb. and 3,726 potential boiler horsepower; 50 on the Illinois Central[2], built by the Lima Locomotive Works in 1926, which weigh 388,000 lb., have 28-in. by 30-in. cylinders, 63-in. drivers, 240 lb. boiler pressure, rated tractive force 69,400 lb., and 3,966 potential horsepower; 12 on the Chicago & North Western[3], built by the American Locomotive Company in 1927, which weigh 397,000 lb.,



Front end of Nickel Plate 2-8-4 type locomotive

[1] *Railway Mechanical Engineer,* May, 1925, page 266.
[2] Railway Age, December 11, 1926, page 1161.
[3] *Railway Mechanical Engineer,* December, 1927, page 781.



Elevation and cross sections of the 2-8-4 type locomotive built by the American Locomotive Company for the Nickel Plate

have 28-in. by 30-in. cylinders, 63-in. drivers, 240 lb. boiler pressure, rated tractive force 67,200 lb., and 3,617 potential horsepower; 105 on the Erie[4], including four lots built in 1927, 1928 and 1929 by the American Locomotive Company, the Lima Locomotive Works and the Baldwin Locomotive Works, which weigh from 443,000 to 461,470 lb., have 28½-in. by 32-in. cylinders, 70-in. drivers, 225 to 250 lb. boiler pressure, rated tractive force 70,000 to 72,000 lb., and from 4,206 to 4,309 potential horsepower; 25 on the Boston & Maine[5], built in 1928 and 1929, by the Lima Locomotive Works, which weigh 393,000 lb., have 28-in. by 30-in. cylinders, 63-in. drivers, 694,000 lb., and 3,923 potential horsepower; 2 on the Toronto, Hamilton & Buffalo, built in 1928 by the Montreal Locomotive Works, which weigh 383,000 lb., have 28-in. by 30-in. cylinders, 63-in. drivers, 240 lb. boiler pressure, 69,000 lb. rated tractive force and 3,712 potential horsepower; 30 on the Missouri Pacific, built in 1928 and 1930 by the American Locomotive Company and the Lima Locomotive Works, which weigh 404,000 to 412,200 lb., have 28-in. by 30-in. cylinders, 63-in. drivers, 240 lb. boiler pressure, 69,400 to 70,500 lb. rated tractive force, and 3,828 to 3,944 potential horsepower. In all cases the tractive force given is that of the main cylinder. In most cases this is supplemented by a booster.

Boiler of Generous Proportions

Special attention was given to the boiler design with a view of providing ample steam generating capacity at all times and for all services. It is of conical design, 86 in. inside diameter of the first course on which is mounted the steam dome and increased to 98 in. outside diameter in the third course over the combustion chamber. The total length of the boiler, including the smokebox, is 44 ft. 8 7/16 in.

The firebox is 135 1/16 in. long by 96¼ in. wide, with a combustion chamber 42 in. long. Outside measurements at the mud-ring are 149 1/16 in. long by 109¼ in. wide. The firebox contains two thermic syphons and two arch tubes. The depth of the firebox from the top of the grate to the center of the lowest tube is 27⅝ in. and the height from the bottom of the mud ring to the crown sheet is 68 in. at the back and 92¾ in. at the front.

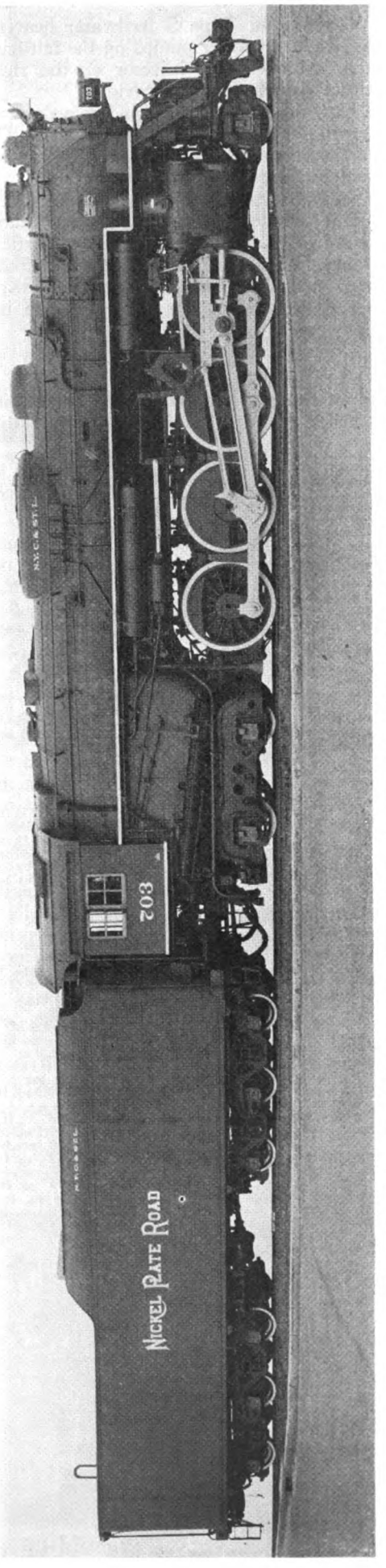
The grate area is 90.3 sq. ft., the grates being of the Firebar type. Three combustion tubes, 2 in. diameter, are provided on each side of the firebox together with suitable steam nozzles. The stoker was furnished by the Standard Stoker Company.

There are 77 2¼-in. tubes and 202 3½-in. flues, both tubes and flues being hot drawn seamless steel. For 10 engines they were supplied by the National Tube Company and for five engines by the Pittsburgh Steel Products Company. The length over tube sheets is 19 ft. The superheater is Elesco Type E and has an area of 1,992 sq. ft. heating surface. Flexible and rigid staybolts were supplied by the Flannery Bolt Company.

The evaporative heating surface totals 4,818 sq. ft., of which 462 sq. ft. is in the firebox, including arch tubes and syphons, and 4,356 sq. ft. in the tubes and flues.

The smokebox is 89 1/16 in. outside diameter and 116 in. long. The smoke stack, the top of which is 15 ft. 8 in. above the rails, has a diameter of 21 in. The exhaust nozzle is 8½ in. diameter. All auxiliary exhausts have been kept outside of the smokebox. This has the effect of keeping all water and condensation out of the smokebox and should improve the drafting.

[4] *Railway Mechanical Engineer*, November, 1927, page 709.
[5] *Railway Mechanical Engineer*, September, 1928, page 491.



One of the fifteen 2-8-4 type locomotives built for the Nickel Plate by the American Locomotive Company

A Worthington Type S feedwater heater is applied with hot and cold water pumps on the left-hand side and a Nathan Simplex NL injector on the right side. A Nathan low-water alarm is provided.

The blow-off equipment, including valves and muffler, were furnished by the Wilson Engineering Corporation, the centrifugal muffler being located on top of the boiler immediately back of the safety valves.

A 9½-in. drypipe leads to the American multiple front end throttle. As will be noted from the illustrations, these locomotives present a particularly neat appearance. This is due partly to the fact that the piping had been placed under the jacket wherever possible. Another noticeable feature of the design is the large

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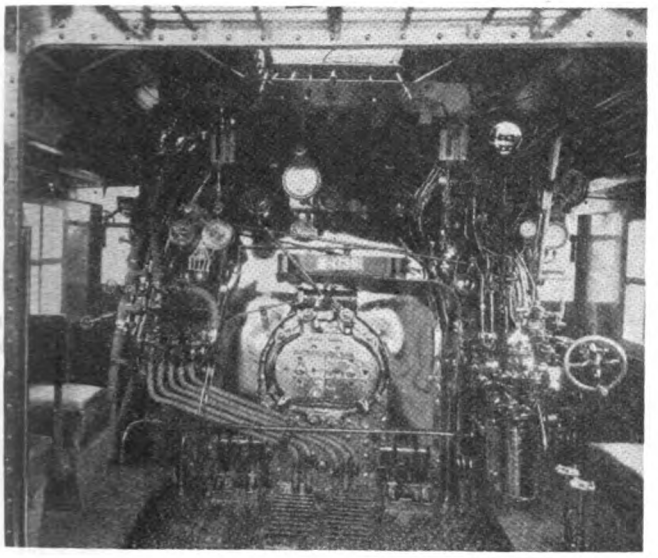
Table of Dimensions, Weights and Proportions of the N. Y., C. & St. L. 2-8-4 Type Locomotives

Railroad	N. Y., C. & St. L.
Builder	American Locomotive Co.
Type of locomotive	2-8-4
Service	Fast freight
Cylinders, diameter and stroke	25 in. by 34 in.
Valve gear, type	Baker
Valves, piston type, size	14 in.
Maximum travel	8 in.
Outside lap	1 11/16 in.
Exhaust clearance	1/16 in.
Lead in full gear	3/16 in.
Specified weights in working order:	
On drivers	254,000 lb.
On front truck	53,000 lb.
On trailing truck	109,000 lb.
Total engine	416,000 lb.
Tender	358,000 lb.
Wheel bases:	
Driving	18 ft. 3 in.
Rigid	18 ft. 3 in.
Total engine	42 ft. 0 in.
Total engine and tender	87 ft. 8¾ in.
Wheels, diameter outside tires:	
Driving	69 in.
Front truck	33 in.
Trailing truck	F. 36 in.—B. 43 in.
Journals, diameter and length:	
Driving, main	R. 12⅝ in. by 13 in.; L. 12½ in. by 13 in.
Driving, others	R. 11⅝ in. by 13 in.; L. 11½ in. by 13 in.
Front truck	6½ in. by 12 in.
Trailing truck, front	7 in. by 14 in.
Trailing truck, back	9 in. by 14 in.
Boiler:	
Type	Conical
Steam pressure	245 lb.
Fuel	Soft coal
Diameter, first ring, inside	86 in.
Firebox, length and width	135 7/16 in. by 96¼ in.
Height mud ring to crown sheet, back	68 in.
Height mud ring to crown sheet, front	92¾ in.
Combustion chamber length	42 in.
Tubes, number and diameter	77—2¼ in.
Flues, number and diameter	202—3½ in.
Length over tube sheets	19 ft. 0 in.
Tube spacing	F. ¾ in.—B. 11/16 in.
Grate type	Fire bar
Grate area	90.3 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	343 sq.ft.
Arch tubes	19 sq. ft.
Syphon	100 sq. ft.
Firebox, total	462 sq. ft.
Tubes	857 sq. ft.
Flues	3,499 sq. ft.
Tubes and flues	4356 sq. ft.
Total evaporative	4,818 sq. ft.
Superheating	1,992 sq. ft.
Comb. evaporative and superheating	6,810 sq. ft.
Tender:	
Style	Rectangular W.B.
Water capacity	22,000 gal.
Fuel capacity	22 ton
General data estimated:	
Rated tractive force, 85 per cent	64,100 lb.
Potential (boiler) horsepower	4,008 hp.
Speed at 1,000 ft. piston speed	36.2 m.p.h.
Piston speed at 10 m.p.h.	276.1 ft.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent.	61.0
Weight on drivers ÷ tractive force	3.96
Total weight engine ÷ comb. heat. surface	61.0
Boiler proportions:	
Tractive force ÷ comb. heat. surface	9.41
Tractive force × dia. drivers ÷ comb. heat. surface	649
Firebox heat. surface ÷ grate area	5.11
Firebox heat, surface, per cent of evap. surface	9.59
Superheat, surface, per cent of comb. heat. surface	29.2
Comb. heat surface ÷ grate area	75.4

Special Equipment Applied on N. Y., C. & St. L. 2-8-4 Type Locomotives

Railroad	N. Y., C. & St. L.
Builder	American Locomotive Co.
No. ordered	15
Boiler:	
Boiler and firebox steel	Otis
Rivets	Champion—Victor
Brace rods	Ewald
Staybolts, flexible and rigid	Flannery
Tubes and flues (10)	National Tube
Tubes and flues (5)	Pittsburgh St. Products
Syphons, Thermic	Locomotive Firebox
Brick arch	Am. Arch—Security
Smokebox hinge	Okadee
Smokebox netting	Cleveland Wire Cloth—No. 398
Superheater	Superheater Co.—Type E
Throttle valve	American Multiple
Lagging (10)	Johns-Manville
Lagging (3)	Philip Carey
Pipe covering	Union Asb. & Rubber Co.—Insu-tape
Feedwater heater	Worthington—Type S
Feedwater check	Nathan
Injector	Nathan—Simplex NL
Injector check	Nathan
Blow-off cock	Wilson
Blow-off muffler	Wilson
Washout plugs	Huron
Arch tube plugs	Huron
Stoker	Standard Stoker
Firedoor	Franklin—No. 8
Grates	Waugh—Firebar
Grate pins	Am. Ry. Products
Cabs; Fittings; Boiler Mountings:	
Safety valves	Coale
Steam gages	Star
Back-pressure gage	Ashton
Water column	Nathan—W.O.A. type
Water gage	Okadee
Gage cocks	Central Valve
Low water alarm	Nathan
Blower fittings	Barco
Turret valve	Nathan
Cocks and valves	Central Valve
Whistle	Nathan
Bell ringer	Viloco
Sanders	Viloco
Headlight generator (10)	Sunbeam
Headlight generator (5)	Pyle-National
Headlight	Sunbeam
Cab lamps	Adams & Westlake
Classification lamps	Adams & Westlake—Adlake
Marker lamps	Adams & Westlake—Adlake
Back-up lamp	Pyle-National
Flexible joints and connections	Barco
Universal joints	Hancock
Pipe fittings	A.R.A.—Crane
Cab clear-vision window	Prime
Cab windshield	Prime
Cab seats	Van Dorn Iron Wks.
Running boards	Diamond plate
Cylinders and Driving Gear:	
Cylinders	Ohio Steel Fdry.—Cast Steel
Bushings, cylinder and valve	Alco—Ni-Iron
Piston valves	Alco
Piston and valve packing rings	Hunt-Spiller—Duplex
Valve gear	Baker
Reverse gear	Franklin—Precision
Metallic packing, piston and valve rod	Garlock
Crosshead	Ohio Steel Fdry.—Multiple-bearing
Crosshead wrist pin	Security
Cylinder cocks	Okadee
Frames and Running Gear:	
Main frames	Ohio Steel Fdry.—Cast steel
Frame cradle	General Steel Castings
Bumper	Ohio Steel Fdry.
Wedges, adjustable	Franklin
Bearings, driving-box, etc.	Magnus
Driving-box cellars	Alco—with spreader
Driving-box cushioning device	Alco
Driving-wheel tires	Ry. Steel Spring
Engine-truck wheels	Ry. Sales—Armco
Trailing-truck wheels, front	Ry. Sales—Armco
Trailing-truck wheels, back	Alco
Trailing-truck tires, back	Ry. Steel Spring
Drawbar	Franklin—Unit Safety
Radial buffer	Franklin
Coupler, engine	Buckeye
Coupler pocket	American Steel Fdry.
Coupler rigging	Union Metal Prod.—Imperial
Engine truck	Gen. St. Cast.—2-wheel outside bearing
Trailing truck	Gen. St. Cast.—4-wheel Delta
Springs	Ry. Steel Spring
Lubrication:	
Lubricator, mechanical (10)	Detroit
Lubricator, mechanical (5)	Nathan
Lubricator, hydrostatic	Chicago
Rod lubrication	Reliance M. & S. Wks.—Spee-Dee
Misc. lubrication	Alemite
Brakes:	
Operating brake	New York—6ET
Reservoirs	70,000 cu. in.
Driver brake	American
Brake shoes	Am. Br. Shoe—Dia. S. Perfecto
Train control (10)	Union Sw. & Signal
Tender:	
Tender frame	Gen. St. Cast.—Water bottom
Tender trucks	Buckeye—6-wheel
Tender-truck wheels	Am. St. Fdry.—Davis
Truck brakes	Am. St. Fdry.—Clasp
Draw gear	Cardwell-Westinghouse
Tender coupler	Buckeye

Tender-coupler yoke	Buckeye
Tank valve	Powell
Suction hose	Goodyear
Hose strainer	Okadee
Miscellaneous:	
Steel castings, misc.	Gen. St. Cast.
Paint, etc.	Glidden—Ripolin



A roomy cab with well-located equipment is a feature of the Nickel Plate locomotive

size sand box which has a capacity of 60 cu. ft. The customary pilot has been practically eliminated, but ample safety steps have been provided.

The cab is large and roomy and the location of all valves and fixtures has been worked out carefully to provide maximum accessibility and visibility. The cab is fitted with Prime clear-vision windows and windshields. The seats are of the Van Dorn pattern, two seats being fitted on the left side.

The chassis is of the built-up construction type. The cast-steel bar frames were furnished by the Ohio Steel Foundry Company and the frame cradle castings by the General Steel Castings Corporation. The cross-ties are of unusually rugged construction, the guide yoke cross-tie being of a heavy box-section design. Sliding shoe supports for the boiler are used at both front and back of the firebox. Particular attention has been given to the bolting of all parts, especially the cylinders which are of cast steel furnished by the Ohio Steel Foundry.

The distributing valves are of the piston type, 14 in. diameter with 8-in. travel. The outside lap is 1 11/16 in., the exhaust clearance 1/16 in. and the lead in full gear 3/16 in. The valve gear is of the Baker type controlled by a Franklin Precision type reverse gear. The piston rods are 5 in. diameter, both piston rods and valve rods being packed with Garlock metallic packing. The crossheads are of the multiple-bearing type and are fitted with Security wrist pins.

The driving wheels are 69 in. diameter with 62-in. centers. The driving boxes have Alco cellars with spreaders and are provided with Alco driving-box cushioning device. Franklin adjustable wedges are also provided. The two-wheel engine truck, which is of the General Steel Castings design, is of the outside-bearing type and has 33-in. rolled steel wheels. The trailing truck is of the Delta four-wheel type, the front wheels 36-in. rolled steel and the back 43-in., steel tired.

The air-brake equipment, which was furnished by the New York Air Brake Company, includes two 8½-in. cross-compound pumps which are mounted in front, ahead of the cylinders. There are three main reservoirs, two 18½ in. by 108 in., and one 18½ in. by 72 in., with a combined capacity of 70,000 cu. in. The brake valves are pedestal mounted. The driver brakes are American, Style WN. Union Switch & Signal Company train control is applied to 10 locomotives.

The tender is of large size, has a water capacity of 22,000 gal., and a coal capacity of 22 tons. It is of the rectangular type with a cast-steel water bottom. Particular care was given to the design of the tank bracing. The trucks are of the Buckeye six-wheel type with 33-in. Davis steel wheels, 6½-in. by 12-in. journal axles and clasp brakes furnished by the American Steel Foundries.

Boxpok Locomotive Driving-Wheel Center

THE improved cast-steel locomotive driving-wheel center illustrated has been designed particularly to meet modern operating requirements and is now in service on a number of railroads, being adapted for application on both new and existing locomotives. It is manufactured by the General Steel Castings Corporation.

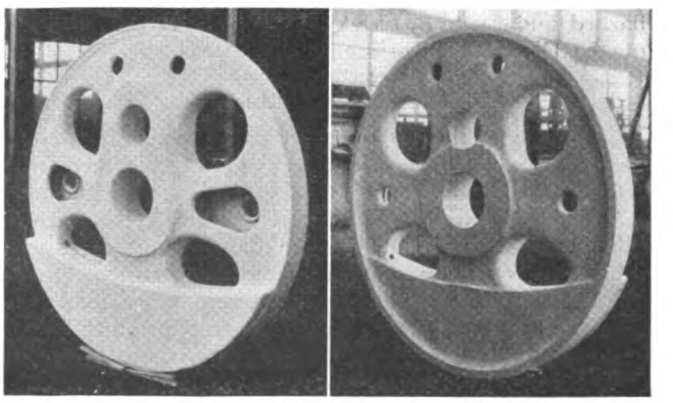
The Boxpok (box spoke) driving-wheel center, as the name indicates, is characterized by having box-section spokes instead of spokes of the usual solid type. In addition, it has a rim of box section. The better and more economical distribution of metal made possible with this design provides greater strength with less weight and also enables the foundry to produce superior castings.

The box-section rim construction, with supporting walls on both sides, has much greater strength and a more uniform tire support and is designed to prevent the development of out-of-round wheels and flat spots. This should increase tire mileage and reduce wheel maintenance. The Boxpok design also has greater strength to resist piston thrusts, lateral forces and impacts from rail, as well as an improved construction between the crank-pin hub and the rim.

The large openings provided in this wheel center give greater accessibility for application and removal of parts, inspection of spring rigging, and lubrication of driving boxes, pedestal shoes and wedges.

The Boxpok design of wheel, with its better utilization of metal, makes it possible to cross balance and to improve counterbalance conditions.

In the development of the Boxpok driving-wheel center, the General Steel Castings Corporation has had the collaboration of the American Locomotive Company and the American Steel Foundries.



Two views of the new Boxpok cast-steel driving-wheel center, as designed for 68-in. main wheels

An Intimate Chat with a Division Superintendent*

Tells the Editor of some of his problems in dealing with mechanical matters

THERE are, of course, all sorts of division superintendents—those on thickly congested trunk lines or at important terminals, and those on railroads serving large areas but with few trains and low traffic density. Or sizing up the situation from a different angle, we have the superintendent under the so-called divisional type of organization, in which he is more or less supreme on his division, the other departments reporting to him. As against this, we have the superintendent under the departmental system, where he deals more or less indirectly with the technical departments. The title does not mean a great deal until one knows more definitely the type of railroad and the nature of the traffic. In the last analysis, however, the division superintendents of all these different types have certain common responsibilities and common problems.

Embarrassing Details

"Do you have any special difficulties in dealing with the mechanical department?" I asked the Division Superintendent of a heavy traffic line—a man of long and successful experience, and a keen observer.

"We get along together very well," he replied, "but there is one thing that I have never been able to understand. Why is it that the mechanical department is so inflexible when it comes to correcting details in design which cause irritation in the operating department? True, many of these things are of comparatively minor importance, but why so much inertia and apparent lethargy? We have been pounding for many years to have some of these comparatively unimportant changes made, but for some reason or other, we don't seem to get much constructive action."

I asked him about certain of these details, but if I were to quote him here it is quite probable they would be recognized and the Division Superintendent might be subjected to embarrassment. He made his point in a decided fashion, however.

"There is another thing," continued the Division Superintendent, "in which the mechanical department is more or less helpless, but which gives me a lot of concern, and that is the arch-bar trucks. I hope that the time will not be extended much further before all of these trucks will be taken out of service. An analysis of accident records indicates the seriousness of this hazard and certainly they do not help to make the life of the Division Superintendent any easier."

Personnel Problems

"How about the personnel of your mechanical department? Do you have difficulty in getting and keeping a high type of mechanical supervisors on your division?"

"We have done very well," replied the Division Superintendent; "indeed, much better than circumstances warrant. As you know, our mechanical-department officers work under strenuous conditions, and more than that, there is often the question of legal responsibility if anything goes wrong. If you compare the conditions under which these men work and the salaries they receive, with the superintendents of small plants along the line, you will find that the latter operate under much easier and less exacting conditions and yet are much better compensated."

"Do you notice any adverse reactions because of this policy?" I questioned.

"Yes, decidedly so," replied the Division Superintendent. "There was a time when I could get high grade students from colleges to enter the service. In more recent years we have not been getting the pick of these men, although, of course, under present conditions we have no difficulty in getting all the help of this kind that we need. I anticipate a difficult time, however, in securing the best type of these men and even in holding the good men we have, when general business picks up."

Propinquity versus Ability

This led to some reminiscing and reviewing of past performances. The Division Superintendent frankly admitted that in a very large railroad organization men of lesser ability are sometimes put into important positions because the talents of men who are better adapted for these positions are not known to those who have the influence or authority to make the promotions. In other words, propinquity in some instances is a considerable factor in selecting the men for promotion.

"In light of these facts," I said, "what can the ambitious young man do to be sure that his talents are not overlooked and that he will not be lost sight of?"

"That is a rather difficult problem," replied the Division Superintendent. "Generally speaking, however, I would say that the young man must do everything he can to extend his contacts and in a diplomatic and tactful way get people to know of his ability. The trouble is, if one is too aggressive in pushing himself, that he may make enemies, or at least he may incur the displeasure of people who can interfere with his advancement. That is one reason why I feel strongly that real diplomacy and tact must be used in extending acquaintanceship and building up contacts, which may bring a capable young man into touch with those who may be in position to help in his climb up the ladder.

"Just one other bit of advice to the young men," he continued. "Tell them not to specialize too highly. This is quite likely to lead into a blind alley. If they do specialize, they should be sure that a way will be left open for advancement. My advice is, don't let your specialty be a hobby."

Help to Get More Business

"In what other way can the mechanical-department employees co-operate with you to greater advantage?" I inquired.

"By helping to sell the railroad to people with whom

* Sixteenth of a series of interviews with men outside the mechanical department, commenting in a constructive way on the possibilities of that department.

they deal, or with whom they come in contact," replied the Division Superintendent. "I do not mean that the employees should make a nuisance of themselves in trying to get business from people with whom they deal, but there are many ways in which, in a quiet, effective way, they can build up goodwill toward the railroad and get business for it. In this way they will really safeguard their own interests. The more business the railroad gets, the more men it will employ and the better wages it can pay."

"Specifically, just how can they help?" I inquired.

"We have had very good results," replied the Division Superintendent, "where employees have tipped us off to the fact that certain of their friends were thinking of making long trips, or that new plants were being built in their neighborhood. The difficulty is that too frequently employees seem to think that the traffic and operating officers of a railroad receive this sort of information automatically; as an actual fact, in some instances employees have called our attention to new plants which were contemplated or being built, concerning which we were entirely unaware. It is better to receive too many tips about things of this sort than none at all, since it is important that our operating and traffic men follow up these leads promptly in the effort to secure business."

Underframes for D. L. & W. Diesel-Electric Locomotives

By F. H. Brehob*

Welded underframe using standard plates and shapes designed to meet low weight requirements. Deflection between center plates, 24.5 ft. apart, held to within ¼ in.

FOUR 600-hp. Diesel-electric locomotives, in which the main frame supporting the apparatus and cab is of welded construction, have been built by the General Electric Company for switching service on the D. L. & W. Two more such locomotives are now under construction for the same railroad.

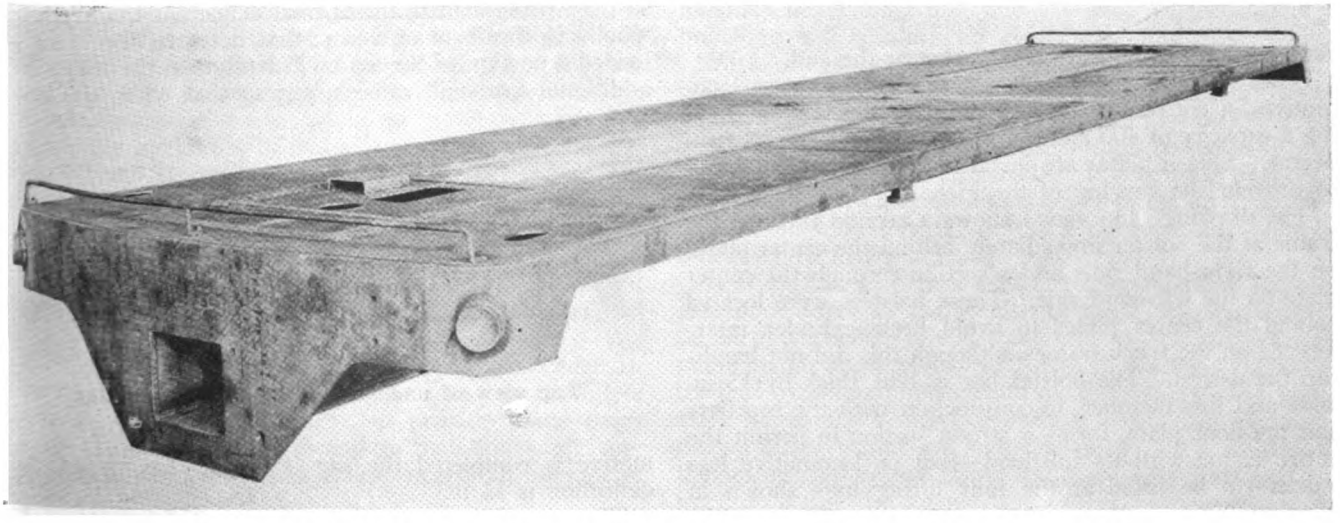
The construction is a rather radical departure from the conventional type of underframe, which is usually either of riveted construction or of cast steel. The frames of these locomotives are believed to be the largest of welded construction. The frame is approximately 42 ft. long, 10 ft. wide and 25½ in. high at the draft-gear housing. It is made entirely of structural shapes and plates, except for cast-steel center plates. The center plates, however, are also welded in place.

On several types of locomotives, depending upon service and other features, it is difficult to build a locomotive within the desired weight, especially a self-propelled design which carries a power plant. The designers of this locomotive have given a great deal of study to welded construction, utilizing standard plates and shapes to secure light construction with reasonable manufacturing cost.

* Locomotive Division, Transportation Engineering Department, General Electric Company, Erie, Pa.

The underframe or platform carries a load of 128,000 lb., not including the weight of the frame itself which weighs 28,000 lb. The largest items of weight carried by the underframe are two engines at approximately 20,000 lb. each and two generators at 9,500 lb. each.

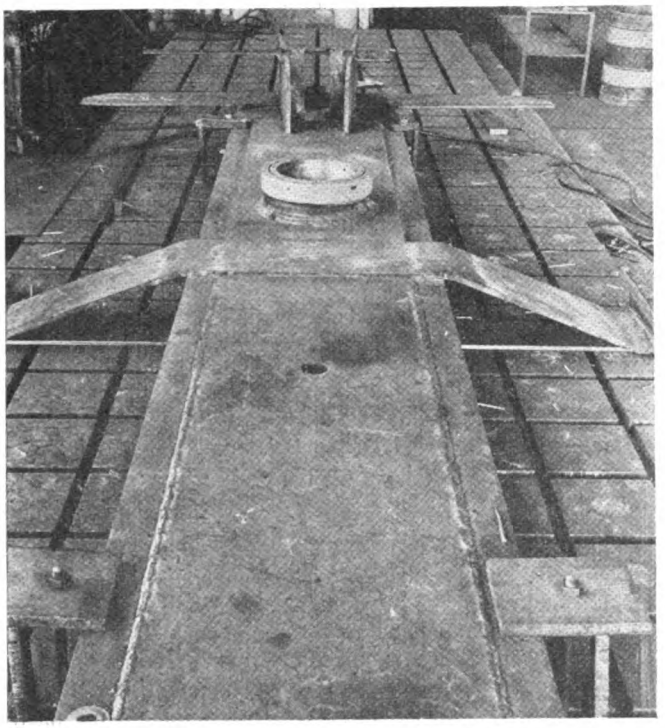
The frame had to be designed with sufficient strength so that the deflection between center plates, which are



Welded underframe for General Electric 600-hp. oil-electric locomotive for D. L. & W.

the supports, did not exceed ¼ in. from center plate to center plate, a distance of 24½ ft. While the stresses are reasonably low, the requirements of deflection were limiting. The engines are bolted to the platform, the engine bases having a flat surface the entire length of the engine for a distance of about 8½ ft., thereby requiring a support having a low deflection. Excessive deflection in the frame would place severe stresses on the engine frame with resultant detrimental effects. The deflection which does occur under the engines is taken care of by soft wood fillers and engine bolts with springs. Another reason for limiting the deflection to ¼ in. is to prevent buckling of the cab side sheets.

To provide for the loading with the above requirements two 13¼-in., 126-lb.-ft. H-beam sections were selected, reinforced at top and bottom with ⅜-in. plates to make a box section. The top plate also forms the floor plate. The main beams were spaced so as to provide for bolting down the engines on the outside flanges. This spacing was also suitable to make a good



Bottom view of partially constructed underframe in the shop during welding process

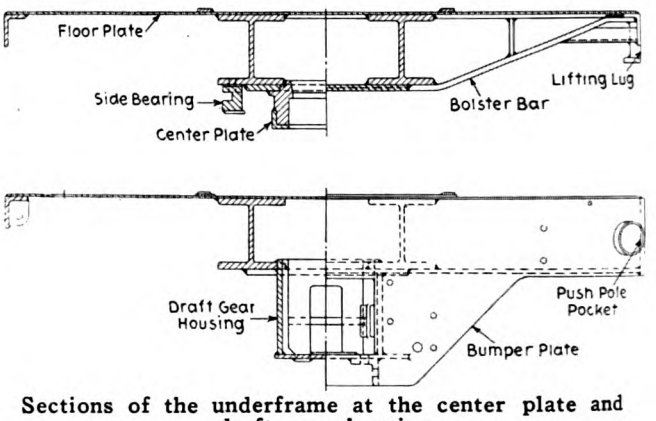
construction of the draft-gear pocket at the end.

Since space is nearly always at a premium on locomotives, a convenient storage tank for the fuel oil, having a capacity of 400 gallons, is located between the main beams. Splash plates are installed crosswise of the tank to prevent the surging of the fuel.

The drawing (top view) shows a section through the frame at the bolster immediately behind the center plates on the right-hand side, and a section through the center plate on the left-hand side. These bolsters were located behind the center plates to avoid brake-cylinder interference on the truck frames, although this did not handicap the design. The bolster bar is 1-in. thick by 15 in. wide and this member, in conjunction with the top bars and the floor plate, forms a strong section to permit the entire frame with its full load—that is, locomotive less trucks—to be lifted at the four lifting lugs shown in the drawing.

The lower view in the drawing shows a section through the draft gear housing on one side and an end view of the bumper plate on the other side and shows how the draft-gear housing is joined to the main beams of the frame. The arrangement of plates in the draft-gear housing is such as to obtain as much direct transmission of load as possible since great strength is required for the buffing and pulling forces. The center of the draft gear through which the pulling or buffing force is exerted is approximately 16⅜ in. below the neutral section of the main beams.

The frame is designed to withstand a buffing force equal to a static load of two and one-half times the weight



Sections of the underframe at the center plate and draft gear housing

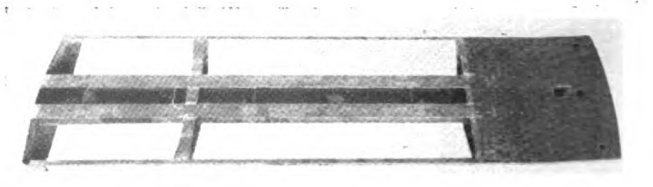
of the locomotive, or 500,000 lb. applied at the drawbar. To provide for this bending moment and direct stress of compression due to the buffing load requires unusually strong construction. To help gain this strength a plate 1 in. thick by 30 in. wide extends from the draft-gear housing to a point beyond the center plate and forms a strong pocket for mounting the center plate.

The end plate on the frame, or, rather, the bumper plate, is 1 in. thick and is securely welded to the beams and draft-gear housing structure and helps to join these two portions.

Method of Construction

The main beams were machined to length and to the desired shape after having first been mated and selected for initial camber.

Whatever initial camber existed in the main beam was used to help provide the frame with an initial crown so that, when loaded, the normal deflection would not be wholly in the form of a sag; that is, when the frame is loaded a portion of the load will straighten the frame and additional load will cause a sag so that when the loco-



Top view of underframe during construction

motive is completed the sag is not ¼ in., though the deflection is ¼ in.

The main beams were placed on a surface table, bottom side up, preserving the camber by placing shims

under the ends of the beams before clamping them down to the surface table. Next, the bottom plates were welded in place, then the bolster bars, which had previously been forged to shape, were welded in place. Following this, the plates forming the draft-gear pockets were put in place and welded, also the end plates or bumper plates, together with necessary minor shapes and plates, to form the desired pocket with projections for mounting the draft gear and coupler.

The plate into which the center plate fits was carefully machined so that the center plate, which is also machined, would make a tight fit in the hole, after which the center plate was further secured by welding.

After doing as much work as possible with the frame upside-down, the frame was turned right side up and supported on the lifting lugs which provided a shorter span than normal between center plates, consequently this helped to preserve the initial crown.

Next the top plates were welded on. The seams between plates were welded first before welding along the sides in order to reduce strains due to expansion and contraction to a minimum.

The principal welds are ¾ in.; that is, each leg where it joins two members is ¾ in. and smaller, depending on thickness of adjoining members. In order to prevent excessive heating and, consequently, excessive warping these large welds were built up in three operations, allowing the welds to become practically cooled before proceeding with the succeeding weld. Care was exercised to be sure that the metal of the joining members was fused to a proper depth and different layers of welds fused properly to each other. Special care was taken to secure oil-tight welds on the members forming the oil tank.

A special welding rod, known as No. W-20, was used. This rod utilizes the covering which burns to provide a reducing atmosphere and a slag covering which prevents oxidation of the weld. This type of rod also produces a weld similar in physical characteristics to the shapes which are welded.

Designing Welded Passenger-Train Cars

By L. F. Seelar

Practices to be considered in taking advantage of economies made available by use of the arc-welding process of assembling component parts

COST of fabrication and building of passenger-train cars can be materially reduced through the use of arc welding and the strength of the frame materially increased without any increase in overall weight. This reduction in cost, which begins in the design and ends in maintenance of the cars, affects both material and labor.

Savings originate with and are largely controlled by the design and it is important that the designer have a thorough knowledge of materials, their possibilities in fabrication, shop methods of fabrication and assembly and the use of the arc weld in assembling parts in unusual positions. Overhead and vertical welds cannot be entirely avoided and the design must provide for an efficient weld when made under such adverse conditions. Sub-assemblies that can be made on the floor or bench should be provided for whenever possible and these assemblies should be carefully inspected as soon as finished, so as to reduce the possibility of rejection after being assembled in the car frame. The subsequent addition of reinforcements to assembled parts requires more time than is necessary for the same operation on the bench or floor.

Economy in the use of material is effected by elimination of deep flanges to provide space for rivet attachment and by avoiding duplication of metal required when parts are riveted or bolted together. In one instance a saving of 1,200 lb. was effected through use of a welded frame in place of a riveted frame at the front end of a self-propelled car. A cast-steel end weighed as much as the riveted end and cost $600 more. The welded end cost $200 less than the riveted end. In riveted structures, it is frequently necessary to use fillers to bring parts into alignment, to provide plane bases for the attachment of parts and to maintain a pleasing appearance. In the welded design, nearly all fillers may be dispensed with.

Reduced costs in designing are obtained through saving the time usually employed for laying-out rivet spacings and checking these spacings through the various pieces to be assembled and through elimination of connections. This saving of time continues through the template department and into the shop where marking, punching and reaming for rivets are eliminated.

Parts are assembled by clamps and an occasional small bolt. Bolts may be as small as ⅜ in. and should never be more than ⅝ in diameter. Parts are first tack-welded in position and after the frame is thus temporarily assembled, all flat welds are made. Where long members are welded, such as continuous cover plates or reinforcements, the welds should be made on both sides simultaneously to avoid warping.

It is a good plan to assemble the underframe bottom side up. After all flat welds are made, the frame may be partly turned over and some otherwise vertical welds made on an angle of from 30 deg. to 45 deg. Turning the frame can be completed and the flat welds on top made after which the remaining vertical welds can be completed, either as vertical welds or on an angle by tilting the frame. After the frame is turned over it should be lined up before the flat welds are made. The assembling of parts, usually called fitting, is practically the same for welded and riveted structures, but permanent attach-

ment by welding is much less expensive than attachment by rivets.

The designer must be fully acquainted with the latest development of the art if he is to obtain the best results. This art is progressing so rapidly that standard textbooks are practically obsolete by the time they reach the public, so that it is necessary that the design squads be kept in constant receipt of reports of tests and work accomplished by the various manufacturers of welding equipment and material.

For purposes of design the car frame may be divided into the underframe, side frame, roof, ends, partitions, and equipment supports.

Considering the underframe and the possibilities of savings due to welded as against riveted fabricated steel, or as against a combination of cast and fabricated steel members, when cast steel is used it must be increased 25 per cent in section over rolled steel to meet the specification of the Post Office Department that tensile stresses in cast steel must be at least 20 per cent less than those specified for rolled steel. This requirement at once places cast steel at a disadvantage as regards weight and when compared to the welded structure, it suffers a further disadvantage as to cost.

Bumper Beams and End Sills

Bumper beams, when fabricated, are usually made of channels or flanged plates with top and bottom covers to form U or box sections. For welded construction, this part can be made of plates cut to shape, butted against

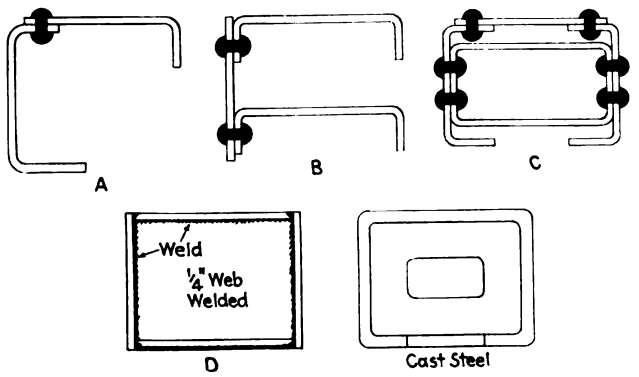


Fig. 1—Bumper beam sections

each other and connected with butt or butt-and-fillet welds. When these parts are riveted together, there is always an opening between them that will admit moisture and the joint will corrode. To prevent this, as far as possible the plates are given a heavy coat of paint when they are assembled and the paint and plaster is frequently inspected and renewed—a heavy maintenance item. When these parts are assembled with a continuous arc weld, it effectually seals the joint against the entrance of moisture, prevents corrosion between the parts and avoids maintenance expense. With all forms of riveted construction, there is a duplication of metal at the joint and this is avoided in the welded joint. There is also an element of slip present in riveted joints that is absent in the welded joint, so that for the same cross section the welded joint is superior in point of weight, strength and maintenance.

Sketches *A*, *B*, and *C*, Fig. 1 show conventional forms of riveted bumper beams. Sketch *D* shows a welded section with a butt-fillet weld between the top and bottom cover or tie plates and the face plate and a fillet weld between the back plate and the covers. Bumper beams of riveted construction with rolled channel sections are necessarily straight across or of the same cross section from side to center. If built of pressed or drawn-steel sections, the cross section may be varied, but heavy forming dies and equipment are necessary. When bumper beams are constructed with the arc weld no dies are necessary, as the pieces can be sheared to shape. Bending, if necessary, can be done on the break and

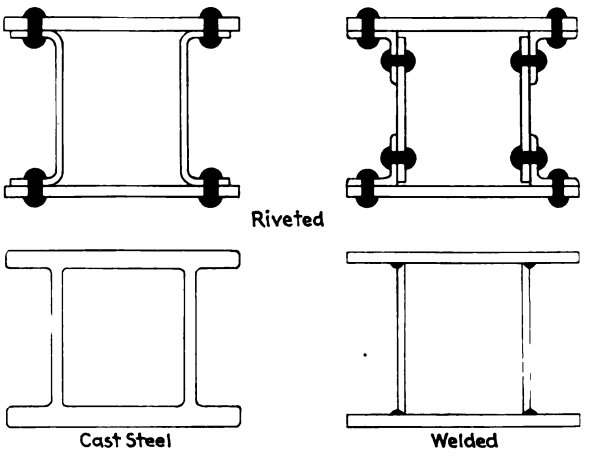


Fig. 2—Bolster sections

forming expense is eliminated. Welded bumpers may be wholly or partly built as a sub-assembly or they may be built as part of the frame.

End sills may be bent plates or rolled sections with anti-telescoping plates welded along the upper edge. Body corner and end posts may be butted on this plate and welded around all contact edges, or the plate may be slotted to receive the end posts, in which case the weld that attaches the posts to the plate seals the opening against the entrance of moisture. So-called "chairs" may be welded to the plate and posts to increase the strength of the end against collapse in collision. The use of the arc weld insures all the end joints against the entrance of moisture and carries the usual saving in labor, handling and material. A light angle will be welded to the top plate of the end sill between the posts and to the posts for the attachment of the end sheathing, when the sheathing does not extend over the face of the end sill.

Bolsters and Crossbearers

Bolsters, Fig. 2, are usually of box cross section of varying depth when riveted and are frequently of box and I section when cast.

When bolsters are riveted, rivet holes are deducted in designing the top or tension members and the top plate

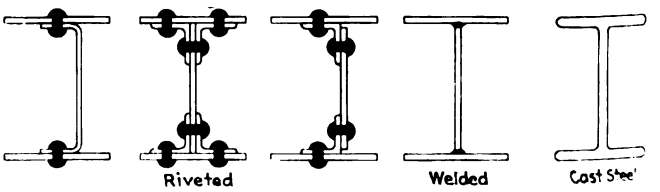


Fig. 3—Crossbearer or needle beam sections

is made thicker or wider than the bottom plate to compensate for this loss of section. There is no loss of section when parts are assembled with the arc weld, and therefore, we have a saving in material in the top member of the bolster. Web plates may be cut to shape and assembled in the car frame by making attachment welds to the side and center sills. Top and bottom mem-

bers may be assembled with tack welds to webs, center and side sills. Side bearing stiffeners, pipe and brake-rod supports or wear plates may be welded to the webs and cover plate before the other cover is put in place.

Ferrules of sheet steel may be passed through the bolster webs and welded in place. These ferrules at once form a seal against the entrance of moisture and form a guide and wear plate for the parts passing through the bolster. Web plates may be assembled with butt or fillet welds. It is possible to attach one plate to the webs with a double fillet weld. In the author's opinion the best construction is to use a butt weld with a small fillet. Direct savings in material and labor by use of the arc weld in constructing the bolsters are elimination of the flanging of the webs, marking and punching rivet holes, making of dies, templates for rivet holes, handling material to and from presses and punches.

Crossbearers or needle beams, Fig. 3, are usually U pressings with top and bottom covers to form an I section of varying depth. Welding this member eliminates the flanges of the web with accompanying savings in handling, punching, forming templates and marking. Construction as an I permits the use of fillet welds on both sides of the web. Welds may be staggered or continuous on one side. If staggered fillet welds or a continuous fillet weld on one side is used, there is an opportunity for moisture to enter between the parts and set up corrosion. It is therefore better construction to use a butt weld, placing a small fillet on the opposite side from which the butt weld is made, as this effectually seals the joint against corrosion. The cover plates are

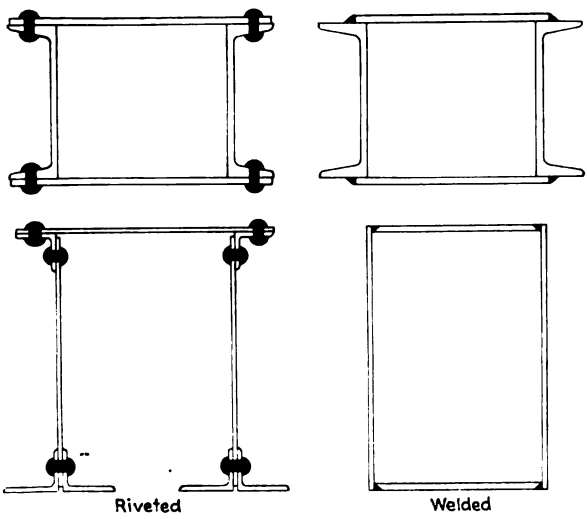


Fig. 4—Center-sill sections

continuous across the car and are welded to side and center sills along all contact edges.

Floor supports are usually of channel section and are often drawn steel pans. A rolled steel Z-section cut square and welded to the side and center sill forms an ideal floor support. For light-weight construction, the Z-section may be made from sheet or plate steel with the flanges turned on a break with a V die. The advantage of the Z-section is that parts may be fastened to either flange with the minimum of interference.

Center and Side Sills

Center sills, Fig. 4, are tied together with a continuous top cover plate and, when of box section, usually have a bottom plate continuous between draft attachments. With riveted construction it is necessary to offset the webs of cross members to allow for the center-sill web flanges and covers, and on self-propelled cars having a steel floor in the cab it is frequently necessary to use fillers to compensate for the varying thickness of cross and longitudinal sill covers. With use of the arc weld it is not necessary that the center-sill covers be a continuous plate from end to end of car. Center sills may be built up box section, fish belly, or a special rolled section when welded construction is used. In arc welding a box-section sill, the cover plates are reduced in width and slightly increased in thickness to maintain the cross section. Using rolled channels for the webs,

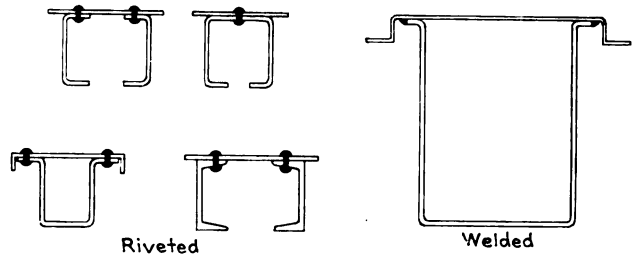


Fig. 5—Post sections

the cover plates are made wide enough to extend ¼ in. beyond the face of the channel web if the flanges are turned outward; if the flanges are turned inward, the cover plate should be 1 in. less than the back-to-back measurement over the channel webs. This permits a continuous fillet weld along the edge of the cover plate and insures against the entrance of moisture.

Cover plates will be cut between the bumper beam and bolster, between the bolster and needle beams and between the needle beams. Butt welds will be made between the cover plates of the cross sills and the center sills so that the entire frame becomes a homogeneous structure. All holes through the center sills should be provided with sheet-steel ferrules and the ferrules should be welded to prevent the entrance of moisture. The arc weld shows the largest saving in the construction of the center sills, as its use eliminates a large amount of detail drafting, templates, marking, punching and handling, of the sills. It is almost always necessary to straighten the long cover plates and this item is eliminated. As before stated, the welding of the cover plates to the center sills simplifies the floor construction and shows a labor saving in this item also.

Side sills are usually a rolled section and they are welded to the bumper beams, bolsters and needle beams along all contact edges. Welds are made so as to exclude moisture between the parts.

Posts and Side Framing

Posts, Fig. 5, are of various cross sections, ranging from rolled steel angles, channels, I and Z's to drawn winged channels and curved sections. Heavy end-post sections used to resist collision stresses remain much the same with arc welded construction as in riveted designs. However, the arc weld simplifies the connection of these members and makes possible a much stronger connection, while reducing its bulk, and eliminates connection angles and gussets. Slots are provided in the welded bumper beam similar to those in cast-steel ends and the posts are welded to both upper and lower bumper plates. The upper ends of posts are welded to the anti-telescoping plates, which are slotted for their reception so that the welded joint is simpler and stronger than a riveted attachment.

Side posts are usually of channel or winged-channel section. In either case, the flanges can be decreased in

width and they can be welded to the side sill and plate and to the sheathing. For the welded joint, flanges should have a width equal to not more than three times the thickness of the post. Twice the thickness is ample for the thinner sections ⅛ in. and less. Posts should be flanged to give them stability while being handled. This also makes a better welding proposition, as the welder can work along the edge of the plate where it is in contact with the sheathing and sills. It is much easier to hold a straight line with a flanged post than with one having sharp edges. A suggested section for a side post for use on a car with stationary windows or glass is one with a winged-channel inner portion and a cover with

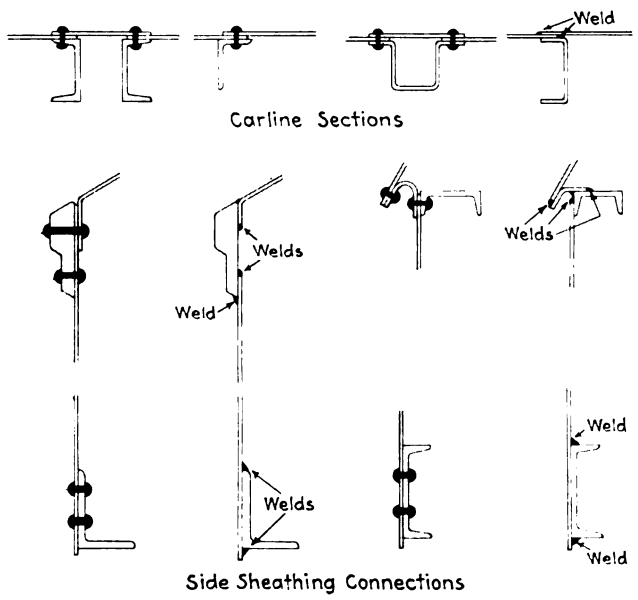


Fig. 6—Side-sheathing connections

a reentrant angle flange that can be welded to form a weather-proof frame for windows.

Side plates of channel, angle or Z-section are attached to posts and telescoping plates with fillet welds.

Carlines of channel section are made up on the bench in pairs and are then attached to the side plates with fillet welds along contact edges. Purlins of channel section can be welded between carlines. The elimination of riveted connections in the carlines and purlins facilitates the building of a smooth strong roof.

Roof sheets are lapped on the flanges of the carlines and attached to them with fillet welds. Small holes for location bolts or screws should be placed in the roof sheets. Holes should be spaced about 30 in. centers and should be puddled welded after the sheets are attached to the carlines. Framing for ventilators, light supports and air ducts can be made as sub-assemblies on the bench and then be welded in place in the roof frame so as to form a stiffening for the structure. These frames may be so designed as to be less in weight than the furrings now used and will increase the strength of the roof frame.

Side Sheets may be held in place with a few small bolts, C-clamps or magnetic clamps while being tack welded. Welding of the side sheets should be carefully done to prevent buckles and, as a smooth weld reduces grinding and plastering, the extra time spent by the welder is compensated for by the saving in the finishing labor. Car sides have been built straight or flat as a measure of economy, but the saving in bending posts and in fitting parts is often lost in trying to remove buckles in the sheathing. A small draw-in on the sides can be easily built into the car and it will eliminate the buckled appearance of the flat side. This draw-in should be included in all welded construction, as it enhances the appearance of the car.

When side sheets are welded in place, the welds should be continuous along all edges. Sheets should extend ¼ in below the side sill and welds should be placed along the bottom edge of the sheet and also along the top edge of the side sill to prevent the entrance of moisture as well as to insure a firm attachment of these parts. Welds between posts and side sheets should also be continuous. It is much better to have a continuous ⅛ in. fillet than a heavier fillet in short sections, as the continuous fillet insures the equal transmission of strains and forms a weather seal.. It is possible to use lighter sections with welded construction on account of the elimination of corrosion hazards, the uniform distribution of strains and the absence of "slip" in the joints. Also, the welding makes a homogeneous mass of the contiguous parts, so that more material can be assumed as resisting imposed loads and a corresponding reduction in cross sections of some vertical members may be made.

Belt rails and window stooling can be welded in place before the side sheets and window sills are put in place. As the belt rail is always of large cross section, the welds attaching it to the posts should be equal to the thickness of the posts. Corners between posts, window sills and belt rails have always been troublesome as they form pockets to catch moisture and dirt. Gas welding and brazing has been used for a number of years to seal these corners. Before and since the advent of the acetylene torch these parts were sealed with copper flashing soldered in place. Neither method has ever been entirely satisfactory as the rivets have always permitted a little motion between the parts and the gas welds have cracked or pulled away and the soldered flashing has loosened. The arc weld has eliminated this trouble as it rigidly connects the parts with a permanent fastening. Every piece can be made homogeneous with its neighbor and detail break-downs are prevented.

Letter panels and eaves can be easily welded along all contact edges with posts, post covers and side sheathing. It is important that the weld along the top edge of the letter panel and the side sheet be continuous to prevent the entrance of moisture. Eaves should be designed so as to permit the removal of the roof sheets without disturbing the fastening of the letter panel.

Interior partition frames may be welded to the car superstructure and the cover panels attached by welds or screws, depending on the material used.

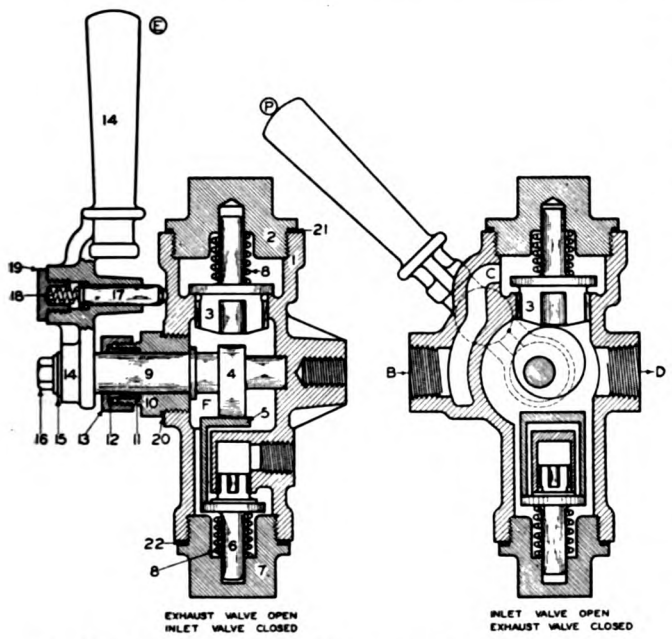
End sheathing can be readily welded to the corner, intermediate and door posts. Ends are always subject to the heaviest collision and operating shocks and the advantage of the continuous weld for tieing the frame together may be most appreciated here.

Reinforcements and frames for doors and windows are more easily assembled and applied by the use of the arc weld on account of the smooth surfaces—unbroken by rivet heads—to which they are applied and also to the fact that the attaching weld weatherproofs all edges while developing the full strength of the part.

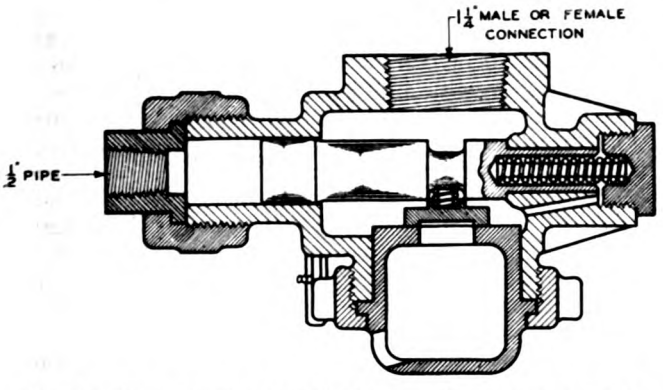
ORGANIST INVENTED LOCOMOTIVE WHISTLE.—The locomotive whistle can claim a musical pedigree. It was invented by an English organist more than a century ago following a grade crossing crash between a train and a farmer's cart on the Leicester and Swannington Railway. In its original form it was not known as a whistle but was called a "steam trumpet."

McLain Locomotive Cylinder Cock

A MAJORITY of the locomotives in this country are equipped with poppet-valve type cylinder cocks which are operated by a series of levers and rods. These cocks seat with the pressure and remain seated until the lever is moved by the engineer, thus raising the poppet valves from their seats and permitting condensation to drain from the cylinders. The



Sectional views of the King operating valve No. 51



Section through the McLain locomotive cylinder cock

objection to this type of cylinder cock is the cost of maintenance of the series of levers, and the fact that if they become bent the cylinder cocks are inoperative.

Some cylinder cocks are operated by compressed air, but the load on the air compressors of modern locomotives is now sufficiently large without coupling another device to it.

The McLain cylinder cock shown here is made by the United States Metallic Packing Company, Philadelphia, Pa. It is operated by steam and consists of a piston which moves a slide valve closing the opening from the cylinder to the atmosphere. Among the advantages claimed for the device are the following: (a) Cylinder cocks automatically open when the engine is dead; (b) if cylinder pressure exceeds boiler pressure by 43 per cent, the cylinder cocks open automatically; (c) slide valve wipes the seat, removing dirt and scale each time the cock is operated; (d) full ¾ in. straight line discharge which may be directed parallel to the right of way or in any direction desired.

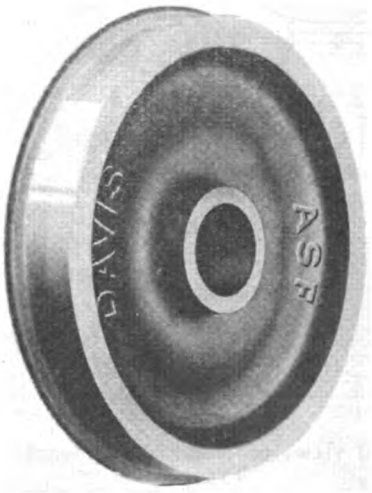
The McLain cylinder cocks are controlled by a King operating valve No. 51, located in the cab of the locomotive, the inlet being coupled to a source of live steam supply and the exhaust piped to the ash pan or some other convenient place where the steam may be exhausted without obscuring the vision of the enginemen.

Whenever the handle of the operating valve is in the position marked "closed", steam flows to the ½-in. inlet pipe of the McLain cylinder cock and moves the piston and the slide valve to which it is connected so as to close the outlet from the cylinder to the atmosphere. When the engineman desires to open the cylinder cocks he moves the operating handle to the position marked "open", whereupon the pressure is shut off from the cylinder cocks and the exhaust valve of the operating valve is opened so as to exhaust the pressure in the line to the atmosphere, whereupon the piston is moved by the spring and the slide valve is pushed across its seat, opening the locomotive cylinders to the atmosphere.

Davis Heavy-Service Steel Wheel

AFTER an extensive period of research, test and development work, the American Steel Foundries began, early in 1933, to manufacture the Davis heavy-service steel wheel for use on passenger cars and tenders. This wheel is made from the same special composition alloy steel and given the same heat treatment as the Davis one-wear steel wheel which has been in extensive use for a number of years.

The special feature of this heavy-service wheel is that it is a multiple-wear wheel with a rim section designed



Davis multiple-wear steel wheel designed to eliminate tread defects caused by heavy service

in accordance with the A. R. A. recommended practice for multiple-wear steel wheels. The rim metal of the wheel has a hardness of approximately 400 Brinell, an ultimate strength in excess of 200,000 lb. per sq. in. and a high degree of toughness.

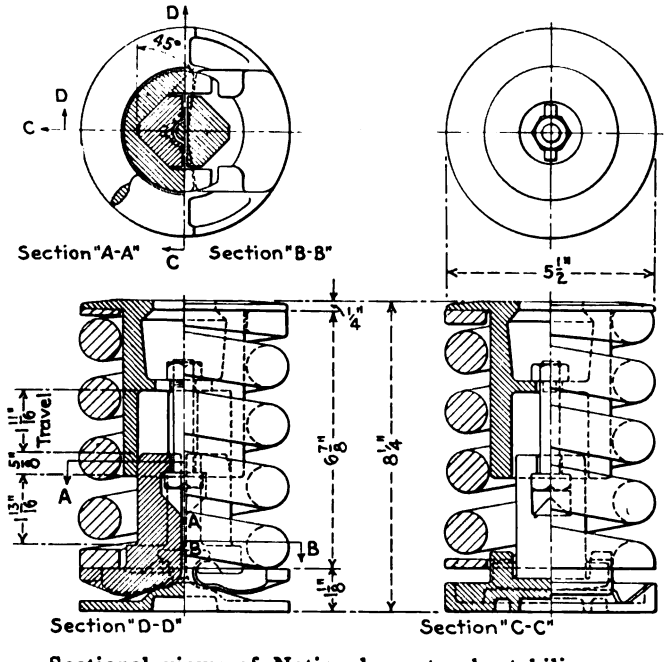
When Davis wheels were first introduced it was ex-

ceedingly difficult to machine the treads on account of the tool and lathe equipment in general use. The developments of the machine tool industry have eliminated this difficulty and for a number of years some roads have been reconditioning the treads of Davis one-wear wheels by turning where it has not been necessary to remove sufficient metal to reduce the rim section to the A. R. A. or I. C. C. condemning limits.

As the Davis heavy-service steel wheel contains sufficient rim metal to permit of three wears, it is a decided improvement over the one-wear wheel for services which require multiple-wear wheels. It is claimed that, because of the special metal characteristics of the Davis wheel, its use in heavy tender service practically eliminates shell-outs and other tread break-down defects caused by heavy wheel loads, this valuable characteristic of the wheel apparently being substantiated by a number of service performance records.

National F-2-A Car Truck Stabilizer

FOR several years the National Malleable & Steel Castings Company has been developing in the laboratory and in service a stabilizer or snubber for car truck springs. The conventional coil spring suspension used in freight car trucks is subject to violent vertical oscillations at certain speeds and this is responsible for a great deal of damage to lading. The series of riding tests



Sectional views of National car truck stabilizer, Type F-2-A

made in the fall of 1933 by the American Railway Association clearly demonstrated the nature of this spring action and showed that the use of properly designed friction stabilizers would prevent the building up of these harmonic oscillations. The National F-2-A stabilizer was included in these A. R. A. tests and was found to eliminate harmonic oscillation at all speeds covered by the tests.

The National F-2-A stabilizer consists of a friction case or housing, a base, two friction levers and a spring which presses the friction levers against the interior surfaces of the housing. One stabilizer is substituted for one coil spring under each bolster end. Any vertical movement of the bolster relative to the side frame causes the levers to generate friction against the interior surfaces of the housing. The F-2-A stabilizer is so designed that proper frictional contact of its parts is maintained regardless of rocking or lateral movements of the bolster.

All parts of the stabilizer are made of the same heat treated alloy steels as are used in National friction draft gears, years of experience having shown that they possess the qualities necessary for maximum shock and wear resistance.

New Adaptations of Simplex Clasp Brakes

A NUMBER of years ago the American Steel Foundries brought out the Simplex clasp brake, which through a system of levers applies retarding force through two brake shoes on each wheel. This arrangement was necessary as the braking load on a single shoe per wheel under modern passenger cars had become so great that the friction between the shoe and wheel had exceeded the point of maximum efficiency.

Later refinements of the clasp brake consisted in removing the air cylinder from the body of the car and mounting two small air cylinders on each truck, this system being designated as the quick-acting unit-cylinder clasp brake.

The truck-mounted cylinders are more accessible for inspection and packing renewals and, owing to their smaller size, are much easier to handle than the heavy 16-in. or 18-in. cylinders used with body brake rigging. This arrangement eliminates the use of body brake rigging, saves weight and leaves the portion of the car underframe between the trucks available for the application of reservoirs, air conditioning apparatus, electrical and other special equipment.

The unit-cylinder clasp brake, being an independent unit, is not affected by curves regardless of their degree. The tendency toward twisting the truck levers on the conventional truck and body brake installation because of the angular pull from the body brake is entirely absent with the unit cylinder arrangement.

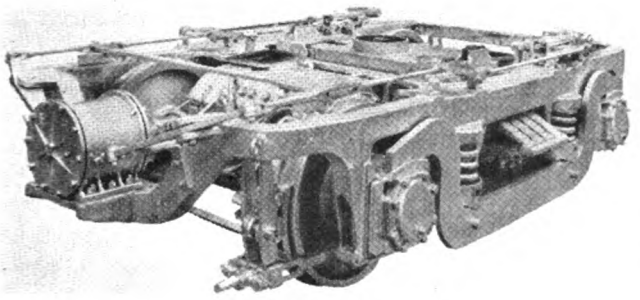
With the advent of the high-speed streamlined trains, an improved braking system especially adapted to the new conditions was essential on account of the low center of gravity and the limited space under the body of the cars. The American Steel Foundries unit cylinder clasp braking system used on the Chicago, Burlington & Quincy Zephyr, involved numerous engineering problems on account of the limited space on the trucks which was available for brake rigging, and the necessity of keeping weights to the minimum.

As the Zephyr is an articulated three-car train, employing a motor truck, two intermediate trucks and a rear truck, it was necessary to design a special clasp brake arrangement for each of the three trucks. The design of the motor four-wheel truck brake involved unusual difficulties as, after the motors were mounted, little space remained for clasp brake rigging or air cylinders. These limitations were overcome by making an extension of the cast steel truck frame on one end and mounting a single air cylinder on this extension,

installing the brake levers and rods above the motors and the truck frame.

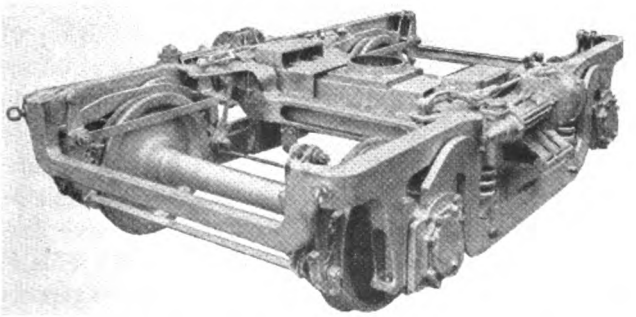
More space was available on the four-wheel intermediate trucks and a small air cylinder with automatic slack adjuster was mounted on each side of the truck frame, as shown in one of the illustrations. This same plan was adopted for the four-wheel rear truck, although of a somewhat different brake cylinder arrangement from the trailer trucks.

In the interest of a high factor of safety, and maintaining weights to a minimum, all parts, including levers,



Simplex quick-acting unit cylinder clasp brake as applied to the front power truck of the Zephyr

pull rods, hangers, etc., were manufactured from alloy steel. All pull rods and slack adjusters were forged solid without welds. All cast parts were made of Hylastic steel, which has a tensile strength of 100,000 lb. per sq. in. and an elastic limit in excess of 65,000 lb. per sq. in. By the use of such high grade steels, a reduction in weight of approximately 30 per cent was obtained. All moving parts, subject to wear, were fitted with high quality, wear-resisting bushings, made from cold-drawn steel tubing, case hardened to the minimum 60 Rockwell "C" scale of hardness and accurately ground both inside and outside to finished dimensions. All pins were made from high-grade steel, case hardened and



Simplex clasp brake application to one of the intermediate trucks of the Zephyr—Air cylinders and slack adjusters are side mounted

accurately ground to specified diameters, and fitted with hexagon slotted nuts and cotters.

To effect the high rate of retardation required to maintain stopping distances from speeds of 100 miles per hour within operating limits, the brake system is designed for a 200 per cent braking ratio at 100 lb. cylinder pressure and the brake cylinder pressure is controlled automatically as the speed of the train decreases. This arrangement maintains a constant predetermined retardation rate and avoids the possibility of slid flat wheels.

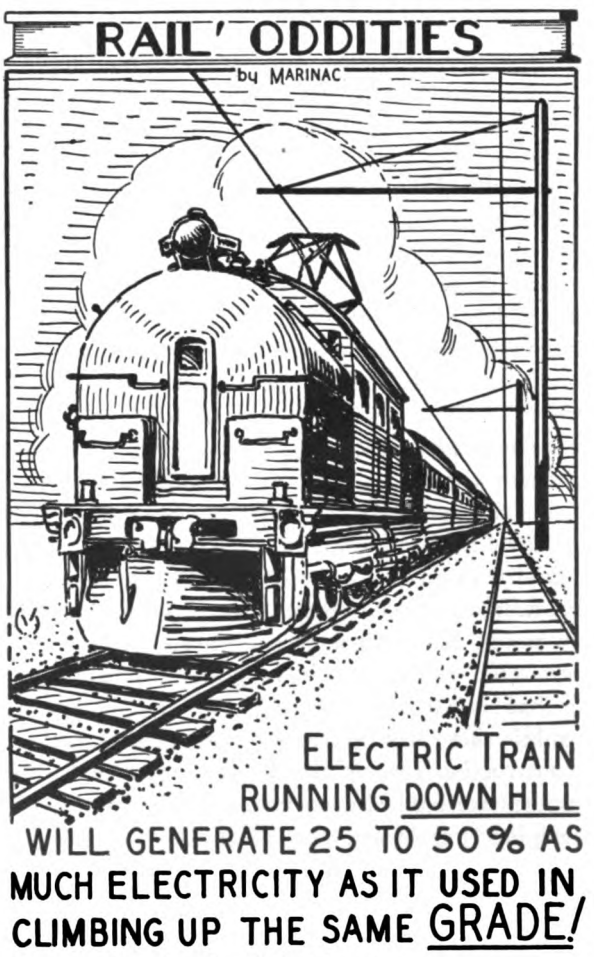
Owing to the fact the Zephyr is a one-way train, or in other words, will always be operated as a unit with the power plant at the front, special features were incorporated in the brake design to assure even brake shoe wear. This involved a change in the usual design of head and mounting so that the center of the shoe pressure would balance the wheel rotation action.

This type of brake is also adapted to produce satisfactory results when applied to standard designs of six wheel passenger trucks.

FIRST LOCOMOTIVE RUN.—The run of the first steam locomotive by Richard Trevithick was made on a bet, according to the New York Times. The famous run was the result of a bet of 500 guineas made between two iron manufacturers that Trevithick's engine would not draw a load from the Penydarren iron works to Abercynon, nine miles down the valley.

Trevithick's own account of the trip is as follows:

"We proceeded on our journey with the engine and we carried 10 tons of iron and five wagons with 70 men riding on them the whole journey. It is above nine miles, which was performed in four hours and five minutes. We had to cut down some trees and remove some large rocks out of the road. The engine, when working, went nearly five miles an hour; no water was put into the boiler from the time we started until we arrived at our journey's end. On the return home, about four miles from the shipping place of the iron (Abercynon), one of the small bolts that fastened the axle to the boiler broke and all the water ran out of the boiler, which prevented the return of the engine until this evening. The gentleman that bet against it rode the whole of the journey with us, and is satisfied that he lost his bet."



Further explanation furnished by the editor upon request

EDITORIALS

Sectional Scales for Weighing Locomotives

The "Chief Engineer," the interview with whom was reported in the October number of the *Railway Mechanical Engineer,* apparently started something when he suggested the installation of sectional scales for accurately checking the wheel-loads of locomotives. Elsewhere in this number will be found a communication from William T. Hoecker, explaining the extent to which European railways provide facilities for determining the individual wheel-loads and the advantages which may be expected from such practice.

At least one American railroad checks up carefully in this respect. "We have found a distinct advantage in the use of sectional scales for weighing locomotives," said a mechanical officer of this road. "We were very much surprised in checking a number of locomotives to find them between 5,000 and 10,000 lb. out, as compared with the specifications. As to the prevention of damage to track, we have no specific information, but feel sure that the correct loading of drivers has more than warranted the installation of these scales."

On the other side of the argument, several mechanical officers have questioned the suggestion of the Chief Engineer. It is claimed, for instance, that the first cost of such scales and the expense of maintaining and operating them is out of all proportion to the benefits that may be expected from their use.

It is contended, also, that the locomotive builders use such scales, and that with reasonable care in maintaining the locomotives as received from the builders, there should be no great variation in the distribution of the weights after the locomotives go into service Occasionally the driving boxes may be keyed up too tight, but this is easily discernible and corrected. There was a time, when the older locomotives generally were being modernized on a large scale, that the addition of new appliances added to the weights or changed their distribution. Most roads, however, have completed their modernization programs and it is claimed that this is not now a serious item to contend with.

One railroad officer suggests that the use of individual scales would cause constant annoyance because of the request that engines be reweighed, the supposition being that such a procedure would be more or less useless unless there has been some considerable change in the construction of the locomotive.

Another mechanical-department officer suggests that "the engineering department has always overlooked the most important factor in connection with driving-wheel weights. Manifestly," he says, "this is not the static weight which would be obtained on scales. Injury to track results more from unbalanced weights due to faulty counterbalance, rather than to inequalities in the static weights. I believe that most of the formulas which are used by the engineering department in designing structures were developed when the influence of unbalanced weights was less than it is now, because the locomotives were much smaller and the weights per wheel were much less, so that these unbalanced forces were not so much a factor in the stresses produced in track and structure as they are now."

We shall welcome further expressions from our readers, either on the basis of actual experience with such scales, or of studies which may have been made as to their possibilities for usefulness.

Reporting Locomotive Defects

Locomotive condition reports usually show the defects and work required, as reported by both enginemen and inspectors. While the reports of some enginemen reflect the true condition of the locomotives, these conditions being corroborated in every detail by the inspectors' reports, certain enginemen allow themselves to indulge in particular hobbies and, consequently, their reports can be forecast almost word for word and give little indication of the real conditions of the locomotives.

For example, as was pointed out at a recent meeting of the Pacific Railway Club, reports frequently include the following: "Engine not steaming," "Engine blows," "Oil engine truck, driver and trailer boxes." It is obviously of no help to the inspectors or the enginehouse supervision for enginemen to report work which will be taken care of normally as a routine operation. It is equally ineffective to concentrate on certain details at the expense of others which may be more important. Maximum benefit from the enginemen's records are secured only when they tell, as nearly as practicable, exactly what the defective conditions are and where they can be located. This is perhaps best illustrated in connection with the reports of engine blowing. When this condition exists, the engineman may just as well add "Examine admission rings (or exhaust rings, as the case may be) on the right valve"; or "Examine right (or left) cylinder packing."

Clear, precise reports by enginemen are extremely valuable to the enginehouse foreman who, in the last analysis, is the man who has to decide what work is non-essential, what can be postponed to some later time and what conditions must be corrected without fail before locomotives can be returned to service.

Smoke Prevention

Communities throughout the country are taking a greater interest in smoke prevention, and undoubtedly this interest will continue to grow in the effort to provide more attractive and healthful conditions. While in most instances the railroads are not the chief offenders—from the standpoint of total smoke production—the smoke from locomotives and enginehouses is very noticeable and the public generally rates the railroads as among the largest smoke producers. The remarkable performance in smoke elimination by the railroads operating in Hudson County, N. J., was commented upon in the October number of the *Railway Mechanical Engineer.*

A unique, and apparently productive, quick survey of air pollution in Scranton, Pa., was made last summer by the Mellon Institute of Industrial Research. The Scranton Republican co-operated in this movement and the survey was made by H. B. Meller and Logan B. Sisson. One usually associates the word survey with long and painstaking research. In this instance the actual observations were made within a week, during the latter part of July, 1933. A thorough survey—or in the terms of the authors of the report, which has just come to hand—"a complete picture would require a year-round study, because seasonal variations in meteorlogical conditions and in the use of fuel are large." However, there is a question as to whether a brief, intensive survey may not answer all practical purposes, at least in the early stages of the movement to improve conditions. Indeed, the report suggests that "the data are to be accepted as *reliably indicative,* rather than wholly conclusive."

Strangely enough, although Scranton is in the heart of the anthracite region, one of the principal sources of smoke is from the bituminous coal burned in locomotives. The other chief contributor to air pollution is dust stirred up by the winds sweeping over the culm piles and barren slopes.

To reduce locomotive smoke it is suggested that as high a percentage of anthracite as practicable be used. This "is based upon the supposition that it will be possible to insure dependability of supply, uniformity of quality and a satisfactory price level over such a period of time as would warrant railroad managements making adjustments necessary to meet the demands for ample power, produced with a minimum of smoke."

It is suggested that a saving in the cost of fuel can be made by mixing as large a proportion as possible of low priced buckwheat with the bituminous coal. It is also suggested that smoke from the building of new fires in the engine terminals can be eliminated. This assertion is made on the basis of results secured in terminals in other cities where special attention has been given to the proper technique for building such fires. Obviously, also, in order to secure real and permanent results, adequate supervision must be provided, although it is suggested that the cost of such supervision may be offset by the saving in fuel and operating costs.

The railroads must have the good will of the public if they are to build up traffic in competition with other types of carriers, and if they are to secure a square deal from the legislators and regulating agencies. With proper care it is possible greatly to reduce the smoke nuisance; it is even contended that in the reduction of this nuisance savings in fuel are made which offset the increased costs of supervision and maintenance. Whether this latter claim is true or not, it would seem that the railroads would be warranted in going a long way in the effort to eliminate smoke as a means of cultivating the good will of the public.

Mechanical Conventions—Two Good Reasons For

Changing conditions in the railway field, as well as in our economic structure, and the possibility of improved business conditions in the not distant future, have been important factors in stimulating a strong interest in the revival of the work of the various mechanical-department associations, and the planning for conventions in 1935. Among the reasons why such activities should be resumed are two which, while of prime importance, are not generally recognized as such.

In the first place, it is now several years since conventions have been held by some of the organizations, and their activities have become almost dormant. In the meantime, because of death, retirement from service and in some cases, demotion, many changes have taken place in the members and officers of these associations. New men have come into supervisory positions, many of whom are very much in need of the sort of coaching and inspiration that they can get by mixing with their fellows from other railroads, exchanging experiences and making contacts which they can follow up to advantage in seeking information. Taking part in committee work and attending the conventions is not only valuable because of the actual knowledge gained and the contacts made, but such experiences are quite likely to prove of great importance in building up the morale and giving a supervisor that confidence which is so necessary in the successful administration of his department.

In the second place, the younger men have been largely overlooked in the depression years. Many of them have dropped out of service and little, if any, recruiting has been done. As business picks up it will be extremely important to remedy this deficiency. Meanwhile, many of the younger men who have been able to hang on, are badly discouraged and are wondering whether, after all, the future in railroad service is worth while. These young men have accumulated a considerable amount of experience and can be made

very valuable to the railroads, if they can be given more encouragement.

One mechanical-department executive is quite insistent that these young men be given consideration in arranging for convention attendance next year, since it may be the turning point in many instances in reviving their interest in railroad affairs and giving them a larger vision of the future possibilities. Certainly they would profit greatly from the experience of attending conventions and this is particularly true if exhibits are available which will permit them to get a good idea of some of the new devices and improved tools and equipment that are now available.

Modernization in Standardization

The development of standards to facilitate the interchange of cars between railways has been the most important function of the Mechanical Division of the American Railway Association. There are, broadly, two reasons for the standardization activities of this organization: (1) the requirements of interchange, and (2) first cost. The most important of the two is the need for standards affecting the repair of cars in interchange, or the ability of cars to withstand the most severe operating conditions to which they may be subjected. This was the major reason for the organization of the Master Car Builders' Association in 1867 and was always the major incentive back of the standardization efforts of that association.

Until just before the war standardization projects were largely confined to details such as couplers, axles, journal bearings, wheels, important dimensions affecting interchangeability of truck parts and draft gears and certain specifications to meet strength requisites in the car structure. Then came the urge for a standard box car, including not only completely standard interior dimensions, but also a complete standardization of the car structure. This was to effect an appreciable reduction in first cost as well as further advantages in interchange. Lacking the urgency which had operated to bring about effective unity of action in the matter of important details, the original standard box-car project did not advance with any degree of rapidity. When the American Railway Association was reorganized following the war, with the merging of the two important mechanical-department associations to form its Mechanical Division, nothing definite had yet been accomplished.

The history of the standard-car developments effected by the Mechanical Division is too recent to need review here. Since 1920 the A. R. A. has adopted a standard stock car, three types of standard box cars and two standard open-top cars. The extent to which these designs have actually been followed in the building of cars, however, has been too small to make the tangible record of achievement in this direction one which can be pointed to with any degree of enthusiasm. These designs have affected the general character of car construction, since their adoption, but they have seldom been adopted as a whole by any railroad.

Increased pressure behind standardization is now suggested by the interest which Co-ordinator Eastman's organization is showing in making effective such standards as have already been adopted. But at the same time we are entering a period in which standardization beyond the essentials needed for orderly interchange has ceased to be desirable. At a time when no important developments in materials or design had taken place for many years standardization by the best utilization of well-known elements seemed to many railway men a logical procedure. With the advent of new materials on the one hand and the growing realization of new requirements for the successful handling of many commodities on the other, standardization beyond that of elements required for orderly interchange and safety of operation, if aggressively pushed, will inevitably serve as a brake on progress. The best method of designing for the use of new materials cannot ultimately be developed until experience has been gained with many designs, each logical enough on paper but not all equally well adapted to the many uncertain conditions of actual service.

The trend of the times is toward centralized control with reduced freedom of action of the individual. Care must be taken that this trend be not allowed to stifle the incentive and energy of individuals—both organizations and men—if the elements of progress now available are to be effectively utilized.

NEW BOOKS

DIESEL ENGINEERING HANDBOOK. *Published by Business Journals, Inc., 192 Lexington avenue, New York, N. Y. 32 pages, 7 in. by 10 in. Pebbled leather binding, engraved in gold. Price, $5.*

The seventh edition of the Diesel Engineering Handbook is somewhat larger in size and broader in its editorial coverage, the treatment being extended to the use of Diesels in the transportation field, particularly railway and automobile service. The first chapter outlines the basic principle of the Diesel engine. The second is devoted to Diesel Economics and is made up of information gathered through contact with users and by employing the data presented before the Oil and Gas Power Division of the A. S. M. E. Other chapters are devoted to developments of new types; planning and installation; electrical equipment in central power stations; water-cooling and purifying systems; lubricating oils and fuels, and operation, care and maintenance of the equipment in Diesel plants, as well as various accessories such as pumps, filter systems and oil purification methods.

THE READER'S PAGE

Sectional Scales for Weighing Locomotives

To THE EDITOR:

On pages 356-7 of the October *Railway Mechanical Engineer*, "Chief Engineer" suggests the desirability of accurately ascertaining the static wheel-loads of locomotives, in order to insure proper weight distribution.

This question has long been given special attention in many foreign countries, where the civil engineer's department generally exerts considerably more influence than is usual on American railways. Facilities for determining individual wheel-loads may be found in the principal shops of practically all European railways. On most foreign locomotives the spring hangers are equipped with so-called "regulating nuts." These are considered necessary, since it is frequently found that although engines leave the shops with weights properly adjusted, after a few trips the springs settle down and further adjustments are required.

When it is considered that foreign axle loads rarely attain 50,000 lb., even on lines laid with rails weighing more than 100 lb. per yard, while 70,000 lb. is common in America, it seems strange that so little regard has been paid to the subject in this country. Some may imagine that only the dynamic augment is of any great importance in its effect on the track and the behavior of the engine, but nothing could be further from the truth. There are recorded instances of leading and trailing trucks being found from 40 to 50 per cent overloaded, with consequent reduction of weight on the drivers, tending to produce a slippery engine. The excessive weight on trucks also increased the resistance to curving to such an extent that considerable damage to the track resulted. In other cases rough riding of fast passenger engines, after the application of one or more new springs, led to the discovery of differences of as much as 10 per cent between wheel loads on the same axle. With such examples as these in mind, it appears rather absurd to calculate counter-balancing and cross-balancing with meticulous accuracy, down to the last ounce and the precise angle, and then to give scant attention to the static weight distribution.

WM. T. HOECKER.

A Desirable Characteristic Of the Unaflow

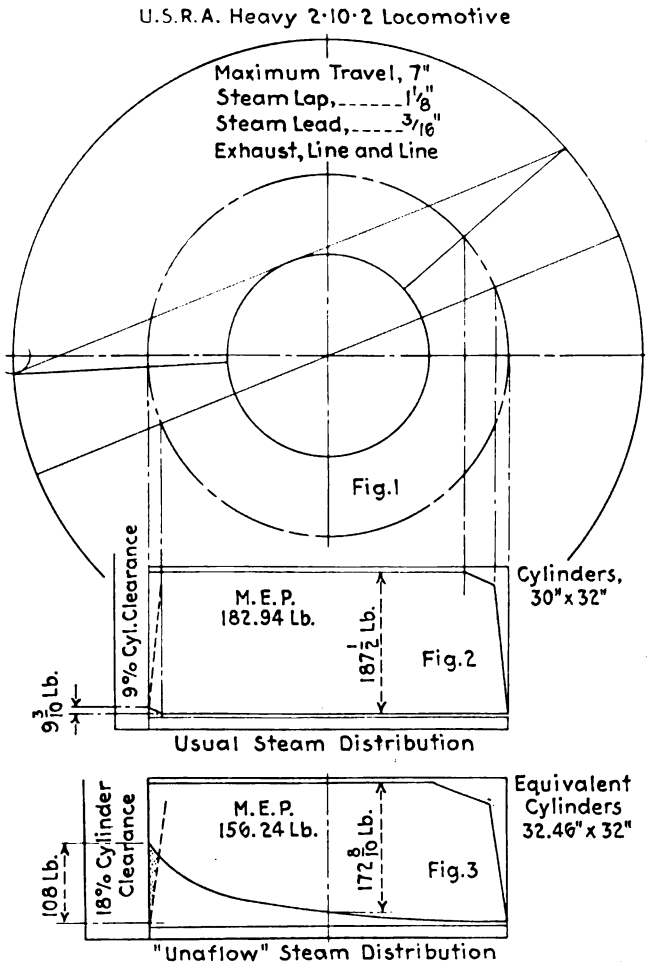
To THE EDITOR:

In looking over reports of performance of Unaflow locomotives on the railways of Germany, Austria, Rumania and Russia the writer was very much impressed by the fact that in all the locomotives in which no provision was made for by-passing a portion of the compression when using the latest cut-off as at starting and on hard pulls for the purpose of increasing maximum tractive force, there was agreement to the effect that "engine ran quietly and without jar." This the writer took as referring to what we know as pounds or knocks in machinery bearings.

This seemed remarkable in view of the fact that most of the locomotives were reported to have been out of shops for some time and were, therefore, somewhat loose in driving boxes and rod bearings and also most of them had no adjustable driving-box wedges.

The heavier reciprocating parts of the Unaflow seemed conducive to the opposite effect, so it was concluded that the reason was to be found in the steam distribution. The practice of taking two indicator diagrams on one card does not seem to have been in vogue in the countries mentioned and the single cards revealed nothing, so cards showing two diagrams were constructed to bring out conditions found on combination.

The writer has chosen the U.S.R.A. 2-10-2 B locomotive for the purpose of comparison. Fig. 1 is a sweet valve event diagram. Fig. 2 is a constructed (theoretical) indicator diagram based upon events obtained from Fig 1. Fig. 3 is a constructed (theoretical) indicator diagram of Unaflow steam distribution, using events given in reports. To bring out the effect of combining the diagrams from the two ends of the cylinder, the writer has transferred the slanting exhaust lines



from the right to the left end of the diagrams, showing the same in dotted lines. This reveals in the Unaflow a rather large, approximately triangular area, shown by shading. This area is net negative work which is quite different from the negative work of back pressure seen

on a single diagram of one end of the cylinder. It starts at nil on the side from which the piston is advancing and gradually builds up to a pressure of 108 lb. at the time of admission opening.

The effect of this is to set up resistance to piston movement which increases gradually as the piston approaches the dead point. The result of this is that at some point between nil and maximum (108 lb.) the piston must stop or lag until the direction of pressure in the machinery bearings between the piston and the engine frame has been reversed and all journals will be thereby seated in the proper direction to receive the thrust of the admission steam. As this has been done by the application of a gradually increasing resistance, no shock can occur and the engine must run quietly. Inspection of Fig. 2, the usual steam distribution, reveals an area of negative work, but as it is microscopic it is of no value.

It is a fact well known to practical men that in locomotives with the right crank leading the left main driving box is usually first to give trouble from pounding. This is due to the fact that steam acting on the right piston causes reaction through the lever formed across the frames by the main crank pins and main axle in such a way as to hold the left main journal away from its proper seating in the box until it is seated by admission with a slam if slack exists.

In the locomotive under consideration the cylinders are 92 in. center to center and the frames are 41 in. center to center. The short arm of the lever is

$$\frac{(92-41)}{2} = 25\tfrac{1}{2} \text{ in.}$$

The long arm is 92 in. — 25½ = 66½ in. I have taken the pressure (187½ lb.) at the center of the stroke as acting on the right piston, say backward. The reaction from this on the left side is

$$\frac{187.5 \times 25.5}{66.5} = 71.89$$

lb. acting forward. Opposed to this we have only 9.3 lb. compression minus the exhaust pressure on the opposite side of the piston at the end of the stroke. It is at once apparent that no backward slipping of the left main wheel to take up slack in the driving box can occur until admission, when it is done with a slam which vibrates the entire locomotive. Now consider the Unaflow. The pressure in the right cylinder at the center of the stroke is 172.8 lb. and the reaction is

$$\frac{172.8 \times 25.5}{66.5} = 66.17 \text{ lb.}$$

Opposed to this we find a pressure of 108 lb. The difference (108 lb. — 66.17 lb. = 41.83 lb.) acts backwards and tends to seat the journal in the box. On the 30-in. piston this aggregates a total pressure of 29,567.95 lb. and is sufficient to produce the slight backward slip of the wheel needed to seat the journal in the box, as the wheel carries only 30,300 lb. When admission occurs no shock can follow, as all bearings are seated to receive the thrust.

An objection to Unaflow in American practice is the increased weight of the piston and its rod which involve heavier balance weights in the wheels, with consequent increase of dynamic augment. This is serious and probably constitutes the only real objection, as there can be none against the slightly longer wheel base required by the long cylinder.

Since the advent of heavy power the problems of maintenance are looming very large, the writer having knowledge of two instances where locomotives can not safely make more than 5,000 miles between drop-pit jobs to make repairs to driving boxes and rod bearings.

This is a very costly item which, with an allowance of loss of service, may run to $100 to $150 per day out of service. In making 100,000 miles between shoppings no less than nineteen such operations are necessary. If pounding in machinery bearings, even when loosened, can be eliminated, at least a portion of the drop-pit work can be dispensed with, probably two-thirds of it. This would mean appreciable savings.

It is the writer's opinion that arrangements can be made whereby the benefits of Unaflow in the matter of smooth running may be had in ordinary cylinders by change of steam distribution which will not cause a loss of more than 1¼ per cent of the original starting tractive force, at the same time showing some economy in the use of steam.

C. F. PRESCOTT.

Adaptability Counts

TO THE EDITOR:

A few years ago, I read with much interest a discussion on "The Reader's Page," having reference to the advisability of a mechanical-department foreman interesting himself in learning something about the workings of his fellow foremen of the different crafts. As I remember, there was only one foreman that was favorable to the idea that it would be a good plan to learn all that he could about the other fellow's job without neglecting his own.

At that time, and all my railroad life, I had been eager to learn as much as possible about anything pertaining to mechanical matters, and have found, since this depression, that I would, without a doubt, have been long since one of the vast army of unemployed had I not paid strict attention to every mechanical operation that I had opportunity to witness.

For a good many years prior to 1930, I had been the head of the car department on a Class I railroad, and had done no manual labor for approximately twenty years. About this time, our railroad changed hands, and then the depression struck, necessitating curtailing expenses. So my job was abolished and I was given the privilege of taking a division foreman's job at an outside point, with the understanding that, in the event that I failed to handle the job, that would be all for me.

The layout was: three switch engines and one local-freight engine to maintain between monthly inspection dates, and this against a bulletin that in the event that a Federal locomotive inspector issued a Form Five ticket against a locomotive, the officer in charge at that point would be summarily dismissed. Then, there were two open interchange tracks with another railroad, four miles apart, that must be covered, and I was the sole mechanic on duty from 3:00 A.M. to 7:00 P.M., and fifty-three years old!

The second day after taking charge, a switch engine tied up at 7:40 A.M. with three loose tires, and I must have this engine ready at 2:10 P.M.—and I had never set a tire in my life! However, I, with the aid of a colored engine watchman, had the engine ready on time, because I had seen it done and hadn't forgotten.

Since that time I have had plenty of harder jobs, and in the four years have had only one engine failure, no engines tied up by Federal inspectors, am still on the job, and like it.

"LANG SYNE."

Lubrication of Railroad Car Journals*

By I. T. Burney†

Practical suggestions on maintenance of packing and qualities of oils to keep hot boxes at a minimum

LUBRICATION consists of interposing a film of lubricant between the metals of a bearing. When the supply of lubricant is ample for the bearing needs there is actual separation of the parts, but when, for any reason, the supply falls off to the point where it is inadequate the metals come in contact and abrade or seize. The oil should be of a good grade and must meet service requirements as to viscosity, flash, fire and pour tests in order to obtain the proper results. Regardless of the grade of oil used the results are largely dependent on how well the men of the car department perform their part of this important task of lubrication.

During the past six years the railroads of this country have shown a wonderful improvement in the miles made per heating failure on both locomotives and cars. Only as far back as 1928 one was not ashamed to mention 40,000 miles per heating failure on freight cars and 100,000 in passenger service, but today heating failures on freight cars showing anything under 100,000 miles, are not mentioned in polite society, and passenger cars must wear the million-mile ticket to gain entrance. This great improvement has been brought about without material changes in the design of any part of the journal box and in the face of increased load per car as well as an increase in the train-miles per hour.

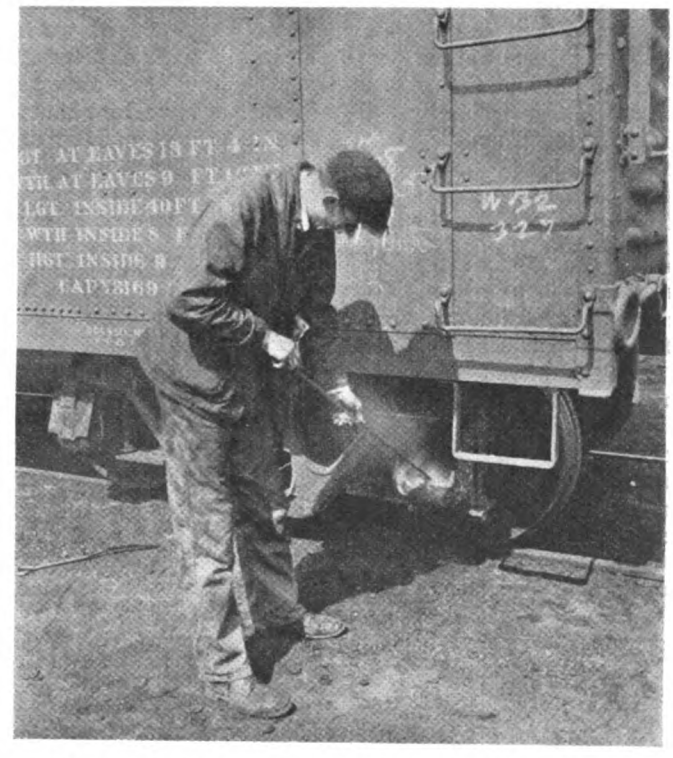
The A.R.A. Committee on Lubrication has adopted standard recommendations for car oils, both seasonal and year round, which, if followed, will furnish the railroads a good standard for quality in the purchase of these lubricants. Some of our roads do not fall in line with the "year round" oil recommendations, feeling that they are justified on account of local conditions.

Importance of Viscosity

In speaking of oils one frequently hears the term "viscosity" and it might be well to give an every-day idea as to what the word really means. The viscosity of an oil at any given temperature is the number of seconds required for 10 c.c. of the oil to pass through an orifice of a standard fixed size. To illustrate, the oil to be tested has been heated to 210 deg. F., and it requires 60 sec., by the stop-wach, for 10 c.c. of the oil to pass through the orifice. That oil is said to have a viscosity of 60 sec. at 210 deg. F. In the United States the standard appliance for viscosity determinations is called the "Saybolt Viscometer" and its findings are spoken of as being "Saybolt Universal".

I think I am safe in saying that the majority of our roads today are using car oils with viscosities ranging between 50 and 60 sec. at 210 deg. F., but some roads, particularly in the south, are still using oils running well into the sixties and, in some cases, going above that viscosity. Again, every once in a while we hear someone calling for an oil of 40 to 45 sec. at 210 F.

There are so many varying conditions to contend with in car-journal lubrication, over many of which no man has complete control, that it is befitting for us to have some reserve power in the viscosity of our oils, otherwise we may look for heating delays. I do not attribute your success in lubrication during the past few years



Miles per hot box have more than doubled in the past five years

* Abstract of a paper presented before a meeting of the Eastern Car Foreman's Association, April 28, 1934.

† Service engineer, Galena Oil Corporation. Formerly lubrication engineer, Boston & Maine, and member of A. R. A. Committee on Lubrication of Cars and Locomotives.

solely to the use of lighter oils, but would rather say that better oil in the boxes has been a large factor. Much of this better oil in the boxes has been brought about through improved renovation of the old oil and periodical repacking of journal boxes.

Improved finishing of car journals in the past few years has helped materially. Some roads grind their journals, others do a good job of rolling. This means better journals to lubricate. When it comes to the job of packing the boxes we are impressed with the advances made, for now we seldom see a box with the packing up against the lower edge of the brass, and the mouth of the box packed solid to keep the lid from rattling.

An oil to be satisfactory must have sufficient viscosity to hold the metals of the bearings apart, for where the oil film is thin heating takes place as the lubricant becomes less viscous, and when heavy loads are carried the metals touch and abrade each other. When an oil is of too low a viscosity and heat is generated, increasing the viscosity to a certain point will reduce the temperature, after which a further increase in viscosity does not result in decreased friction, as increasing the viscosity of an oil also increases the fluid friction and this will cause a rise in temperature. On the other hand, the sustaining power of a bearing is often increased by using a more viscous lubricant, notwithstanding the increased friction and resultant heating.

The A.R.A. Committee on Lubrication in its recommended specifications for car oils has been endeavoring every year to flatten out the viscosity curve, or, in other words, to lower the viscosity at 100 F., without a corresponding decrease in the seconds viscosity at 210 F. The flatter this viscosity curve can be made, other things being equal, the less fuel will be wasted in overcoming friction heat in the bearings. Loss of fuel in overcoming the friction caused by poor or unsuited lubricants applies to locomotives as well as to cars. The higher the temperature at which bearings run the greater will be the loss in fuel, as it requires coal to overcome the excessive friction which brings about the higher temperatures of bearings. If a bearing runs 30 deg. warmer with oil No. 1 than it does with oil No. 2, you will certainly burn more coal doing the same amount of work when using No. 1 oil than you would with oil No. 2. This applies to bearings lubricated with grease as well as with oil. In making tests of prospective lubricants it is always important to make temperature readings at the same time.

Application of Lubricant and Maintenance of Parts

So far, I have dealt principally with the lubricant; now I wish to get to another and most important part of our subject, that of the application of the lubricant and the maintenance of the parts involved.

The method of applying the lubricant remains the same as it has been for years, by the use of wool, cotton, or a mixture of both cotton and woolen packing as the carrying agent. We need not devote our time in discussing which one of these are best suited to the work, as all are permissible, but may confine ourselves to the statement that it should be of good grade, free of foreign matter and dirt and of as long strands as is practical within a reasonable price range. Packing which carries an excessive amount of lint is undesirable, as we frequently have heatings charged to waste grabs, which in reality were caused by an accumulation of lint on the loading side of the brass, so that when the journal brass was lifted from its bearing, due to shocks from striking standing cars or emergency application of the brakes, the rotation of the journal carried the lint up under the brass where, on the brass again seating itself, it was caught under the load. It has been claimed that the use of the light oils will overcome much of this trouble. I hope this proves true, but can see but little on which to base the hope. When we had the heavier oils, it was claimed that particles of waste saturated with the heavy oils would stick to the journal and be carried up under the brass and, with the use of the lighter oils, this ability to stick to the journal would be lessened to a noticeable degree and improved conditions would result.

Granting all these claims to be true, we have now reduced the possibility of strands of packing being carried to the brass by adhering to the journal, but what of the new conditions we have with us in the use of the light oils—that of these light oils readily being precipitated, leaving the top of the packing very dry? In fact, samples withdrawn from many of these boxes did not have oil enough in them to soil one's hands, and when this condition exists we are bound to have flying lint in the box and the journal action will carry it toward the brass.

The present standards in packing journal boxes should have some influence on the waste-grab situation, for if we keep our packing one inch below the center line of the journal we should not be so liable to have stray strands of packing ready to be caught under the brass at the first opportunity as was the case when the packing was always up against the edges of the brass. Keeping the packing down one inch below the center line will result in far better lubrication than with the higher packing in the boxes.

Another forward step was made when the use of the hard-wound back roll was made optional. Making the so-called "front plug" optional was a good move, and the sooner its use is ruled out the better off we will be. This packing in the front of the box did nothing but prevent a proper inspection and setting up of the packing aside from being an uncalled for waste of packing.

The general practice of applying new brasses at the time of new wheel applications has helped greatly in keeping down heatings after doing this work. When wheels are applied many serviceable brasses are removed and, if some practice is developed with which the full radius of the brasses so removed can be restored, there is no reason why such serviceable brasses cannot be again put back into use on home line cars and in this manner save quite a bill for new brasses.

Reversed Movement of Cars

Many roads are confronted with extensive reverse movements of heavy loads out of some of their terminals and it might be well to devote a little time to what can be done toward keeping down heatings on cars involved in such moves. I think all of us have had our troubles with cars of this class. The box conditions mentioned in the preceding paragraph have a strong influence on the performance of cars encountering reverse movements. A well packed car starts on a run of 200 miles, straightaway, and during this run the journal motion is in one direction, setting up the following box conditions: In passing over the packing the journal picks up a supply of oil, carrying it up to the point of load, where, when coming under the load area, the pressure forces a part of the oil off the journal. This excess oil is carried up by the journal, then falls from the loading side of the brass onto the warm packing, where it is quickly precipitated. When this car arrives at the end of the straightaway run we find the off or unloading side of the packing very dry, while the on or loading side is well saturated, but after standing a short time in warm weather the excess oil on the loading side will gradually fall away from the journal toward the bottom of the box, leaving the entire mass of the packing fairly dry. If this car continued in the straightaway move there would still be enough oil

left up in the packing on the loading side to take care of the journal for a considerable more mileage, but let's look at the condition when the movement is reversed.

The direction of journal rotation is now reversed; the well-saturated part of the packing which was the on or loading side now becomes the off or unloading side, and the dry packing which was the off or unloading side now becomes the important on or loading side of the bearing. The reverse movement in the rotation of the journal now causes the journal to leave the unloading side of the brass and immediately pass over the best saturated part of the packing, where it picks up its supply of oil, but, as it continues to move across the packing, it encounters the dry condition, of what was formerly the unloading side of the packing, where it gives up most of its oil to replenish the supply in the dry packing, thus passing along and coming under the load lacking ample oil with which to force a separation of the metals of the bearings. In order to keep down heatings on reverse movements it is essential to have the packing ironed properly.

Requirements for Good Results

Some roads resort to the use of free oil and in many cases it is needed, but this method of treating, while it requires fewer man-hours, is not to be compared to the proper servicing of boxes with the packing iron. I have always termed "free oiling" as being a "shot in the arm," for the reason that it will help out for a short mileage but over long distances is not adopted to good service. Most boxes have plenty of oil in the bottom waiting to be forced up through the packing by means of the iron and adding more oil to the top of the packing where it will soon precipitate and join the other at the bottom is not good practice and causes waste of lubricants.

To get good results from car lubrication there must be close co-operation between the car and operating departments in order that cars may be switched or humped and placed on the outgoing tracks as long before the departure of the trains as possible. Many operating officers



A shot of free oil can never take the place of proper servicing

are not conversant with lubricating conditions, therefore fail to see the difference between servicing boxes prior to, or after they have been switched or humped. I have had occasion to go into such matters and have been told it made no difference when servicing boxes as long as the work was done. If these officers will take time to inquire into this phase of the work, I feel sure they will see that it makes all the difference in the world in the running of the cars whether the boxes are worked just prior to leaving time or after their arrival and prior to their being made up into the train. I have frequently had a string of cars worked prior to their being switched, making a close check on the conditions found after the switching or humping had taken place. In practically every case I found the packing displaced and in no condition to start a long run.

Results from Switching

A few years ago one of our largest roads conducted some interesting and enlightening tests to determine just what effect heavy shocks to cars would have on brasses, wedges and packing. The method used to get the findings was to push an empty car at various speeds, allowing it to strike standing cuts and noting results. It was found that when this car, moving at a speed of 2 miles an hour, struck the standing cut the journal brass was raised $\frac{1}{8}$ in. off the journal. Again, this same car moving at a speed of four miles an hour, striking the standing cut, lifted the brass $\frac{3}{8}$ in. off the journal. At four miles an hour the packing was displaced to the extent that it touched the brass on one side. At six miles an hour bearing raised 17/32 in. and the packing started out of the mouth of the box. At $7\frac{1}{4}$ miles an hour the brass and wedge were displaced and a large part of the body of the packing was caught under the brass when it reseated itself. Dragging this car with the brakes set after one of the shocks caused the brass to raise from the journal. Emergency brake application at slow speed caused the brass to raise and the packing was caught, forming a waste grab. In citing the above facts I hope to make clear my point regarding the desirability to service the boxes after, instead of prior to, heavy switching movements.

Winter Troubles

During the summer months servicing journal boxes does not present the difficulties which are confronted when severe cold weather arrives. During the past winter, well, most of us would just as soon forget just what they found themselves up against. With temperatures ranging from zero to 50 deg. below we had "rolling packing" to add to the difficulties which are experienced at such times to keep the packing set up. It was not unusual to see cars moving past with the packing resembling small cabbages hanging from the mouths of the boxes and if the car reached the terminal without being set out, the next problem was to get this frozen mass of packing back into position in the box.

It is not necessary to recall further what you were up against. The thought in your mind at present is "Tell us what to do to overcome such a condition in the future." I wish I could give you a practical solution, but I cannot. Theoretically, the answer would appear to be "Keep the moisture out of your boxes and you will eliminate a large percentage of this trouble." But we know this cannot be done where cars are handled through the snow belts, for the flying snow will find its way past the best fitting dust guards and journal box lids, and moisture in the box is the result. With exceedingly low temperatures this moisture freezes the packing to a solid mass, and where the packing comes in contact with the journal

it seizes. Then, at the first movement of the journal, the whole mass follows the journal to the edge of the brass and when forced by the great pressure to break away it is forced out of the mouth of the box.

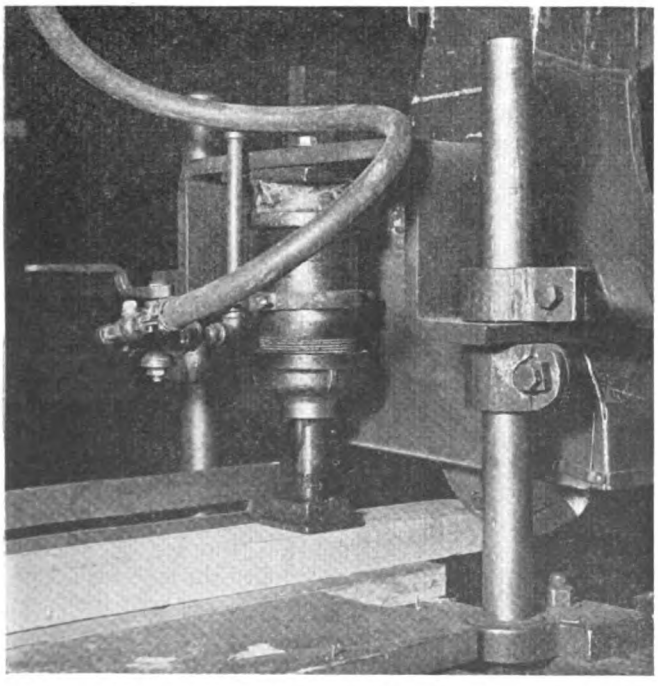
When boxes arrive at a terminal in cold weather there are always small particles of water collected about on top of the packing, due largely to the melting of the snow, and where possible to work the box immediately with a good iron, these particles of water gather and fall down through the packing to the bottom of the box out of reach of the journal and the moisture content of the packing is thus greatly reduced. At the same time the oil, still being warm, is easily forced back through the packing up against the journal, and in doing so forces a portion of the moisture farther from the journal. I found this procedure was limited to the care of passenger cars and this equipment, when so treated, did not roll the packing nearly as much when the train was again moved from the yard to the station.

Pneumatic Clamp for Car Tenoning Machine

TO provide a positive device to hold material on a car tenoning machine, the pneumatic clamp shown is used on the Chicago & North Western. The clamp is built of a piece of 4-in. wrought-iron pipe bored out and threaded on each end. Two pipe caps are used as pressure and non-pressure heads of this cylinder, the upper one being welded onto a square piece of iron ¾ in. by 6 in. by 6 in. This upper piece is tapped at each corner for ½-in. cap screws which run up through slots cut in the supporting iron. By means of the slots, the cylinder can be moved to any desired location on the table to accommodate the various widths of material run.

The non-pressure head of the cylinder has a guide sleeve welded on, through which the piston rod operates. A 4-in. cup leather is used on the piston, and the bottom of the piston rod is riveted onto a roughed-up casting to insure a better grip on the material. The air hose leading to this hold-down clamp is connected to the supply line with a union which is disconnected each time a job is completed. A check valve is also installed next to the control valve so that if the hoses should burst the air in the cylinder would be checked at least until the cut was completed. The control valve is a three-way valve, which admits air into the cylinder in one position and exhausts it in another position. A release spring in the cylinder brings the piston back up to the top of the cylinder.

The effectiveness of this hold-down clamp will be appreciated when it is realized that a pneumatic pressure of 90 lb. per sq. in., namely, that of the shop air line, is provided against the piston, thus assuring that the work will be held down firmly and safely. In addition, the ease of clamping and releasing the work is a valuable time- and labor-saving feature.

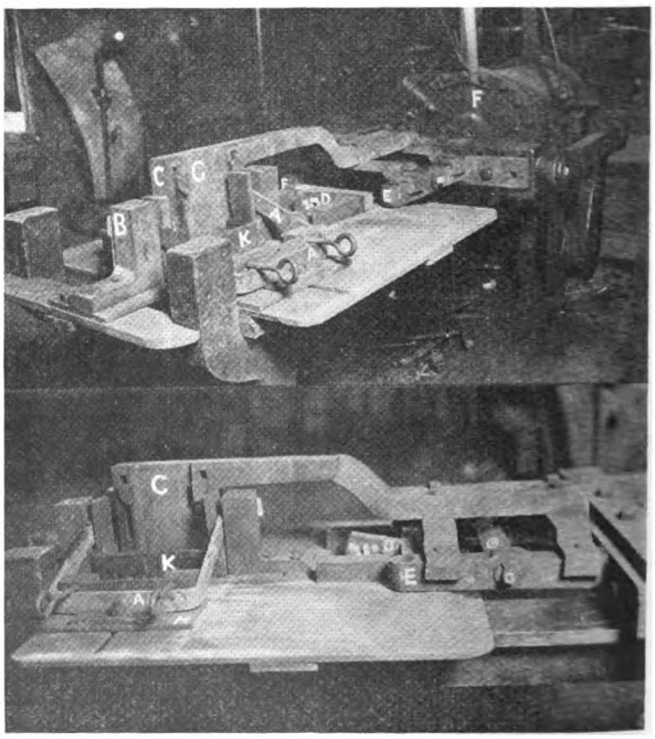


Pneumatic clamp applied to a car tenoning machine

Shaping Sill Steps

A SILL step bending device, or tool, developed and successfully used at the Boyles (Ala.) shops of the Louisville & Nashville, is shown in the illustration, being adapted to the making of 24 different types and sizes of sill steps.

This tool, as described in a recent issue of the L. & N. Employes' Magazine, is designed to be used in conjunction with a horizontal pneumatic press, operated by an 18-in. by 24-in. cylinder carrying 90-lb. maximum air pressure. A chart shows the size and length of stock required for the various shapes and the stock is placed in separate piles at the furnace with the shape number marked on one piece in each lot for identification by the heater and machine operator. The heater puts all pieces of one shape into the furnace and the machine operator makes his adjustments for this shape by first setting the part *D* to the required angle. If it happens to be a step which has an edge offset as the one shown at *A*, this is



Sill step bending device used at the Boyles (Ala.) shops of the L. & N.

done by dropping the tongue *D* through a slot in the plate and placing a ⅝-in. steel pin in the hole, which gets a bearing on the plate when the desired angle is obtained.

The operator then adjusts the tool for the length of the step. This is done by sliding the small plate *H* to a line marked on the large plate which has the shape numbers of the different steps stenciled on it. This eliminates the use of a blue print or measuring for lengths as the operator knows the particular shape of step that is being heated and arranges the die to line up with this shape number on the plate.

After the material has been heated, it is first placed across the plate in front of the tool at *E* and with the forward movement of the piston the step is bent in a U-shape and the necessary edge set is made by the pressure forcing the square roller *G* to conform to the angle previously set at *D*.

The step is then taken out and placed at *H* where a suitable strap shown at *K* holds it up to the proper height on the end. For the last operation, turning back the ends, it will be noted that die *C* is in the center of the step and the movement from this position both forward and backward bends both ends as the adjustment lugs shown at this point throw the ends down and square with the step at *A*.

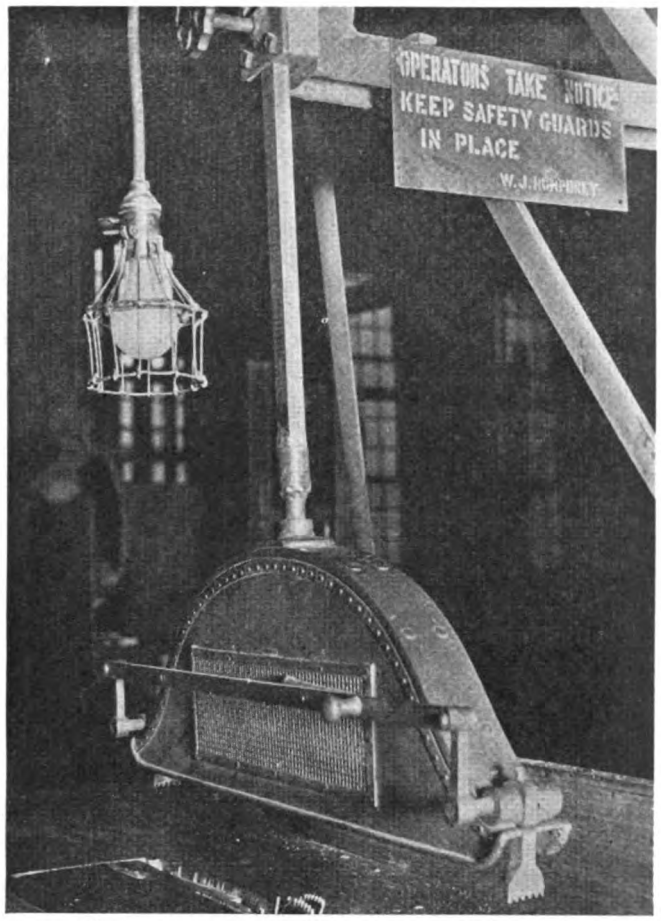
This die will make any step of the type shown at *A* from 8 in. to 16 in. in length with offsets ranging from a square step with no offset to one with a 5-in. offset.

Three Safety Devices At C. & N. W. Car Shops

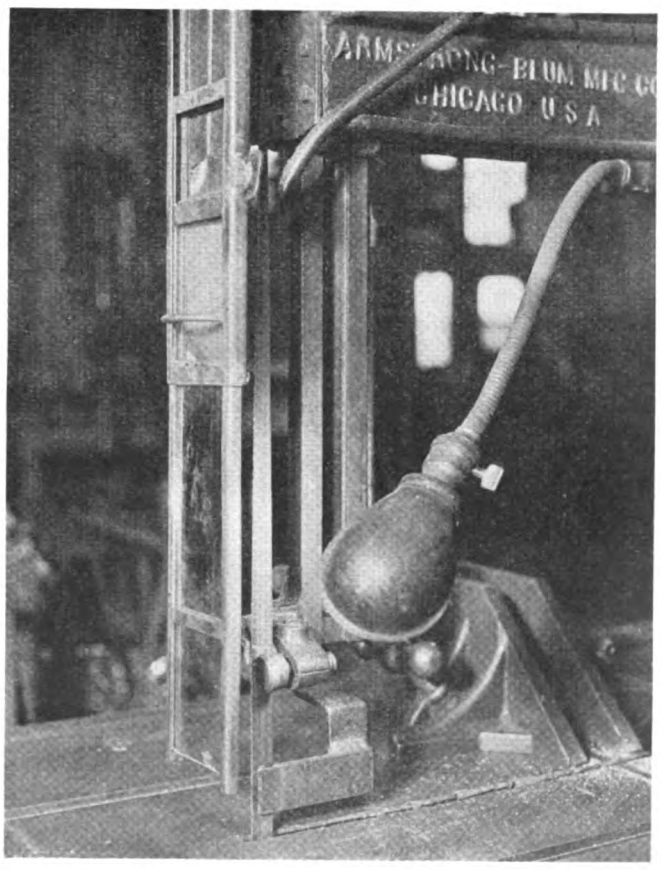
THREE safety devices which are saving time and labor as well as contributing to safety at the Chicago passenger-car shops of the Chicago & North Western are shown in the illustrations.

The first of these is a circular saw guard of the type used on hand-feed rip saws. The guard is built up of wrought iron, sheet iron, netting and steel. This guard has an up-and-down adjustment of about 20 in. and can be locked in any desired position by tightening the lock screw. This guard has both front and rear kick-back dogs and they work together. They are always returned to the position illustrated as soon as the material is through the saw. This action is brought about by a coil spring fastened to the connecting bar and to the main part of the guard. When material is to be run through the saw, the guard is set so the kick-back dogs are pointing ahead at about a 45-deg. angle. The teeth on these dogs are kept sharp at all times and they act to prevent a kick back, as the closer the dog is to a vertical position the less space is left between the table and the teeth. This causes the lumber to be wedged between the dogs and the table top and, in this way, it is locked.

The second illustration shows a safety guard of the type used for metal cutting band saws. It consists of an inner and outer frame made of 16-gage sheet steel joined by welding. The outer frame remains fixed and is secured to the top arm of the carriage by angles and bolts. The inside frame is equipped with ¼-in. plate glass 4 in. wide, and this frame can be set to the desired vertical adjustment by using a handle as provided and secured in position with a thumb screw threaded to the boss on the right side of the fixed frame. The range of adjustment is from ¼ in. to 15 in. above the table top. The distance between the glass and saw blade is 1-½ in. This guard has been found to be a very practical device in avoiding injuries particularly when cutting sheet-metal



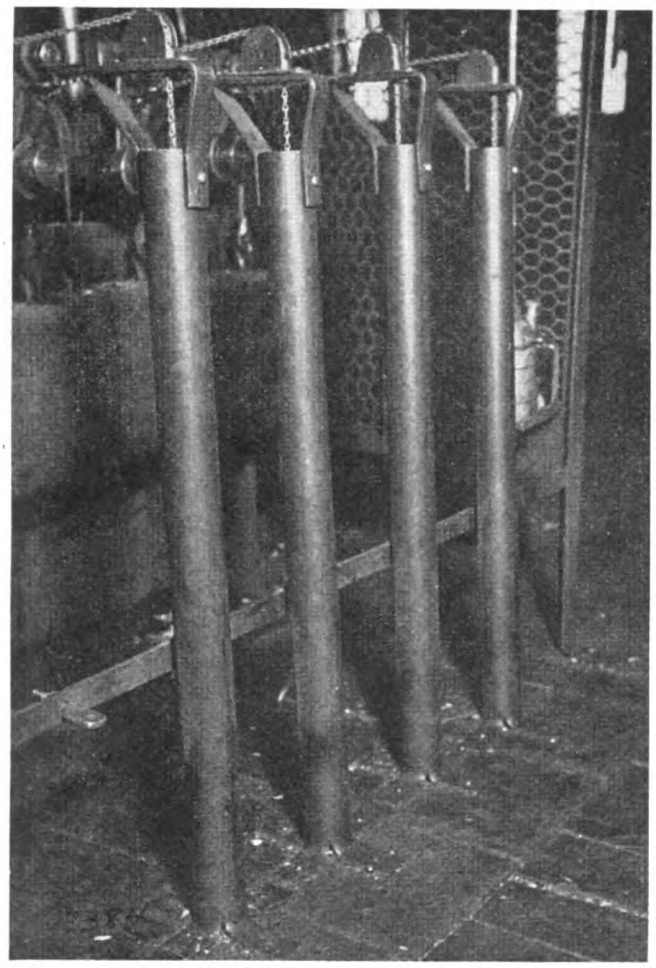
Circular saw guard used as a safety device to protect the machine operator



Safety guard as installed on a metal cutting band saw

parts which cannot be fastened down by clamping.

The third illustration shows a safety device applied to a four-spindle horizontal wood boring machine. Occasionally, one of the boring spindles works forward, due to the vibration of the machine and the device shown is designed to overcome that hazard. It is built of a piece of sash chain fastened to the rear end of the boring spindle and run back over a sash pulley and down into a piece of 2-in. iron pipe. A piece of 1½ in. diameter round iron about 7 in. long is attached to the other end of the sash chain. The pipe is held in a vertical position by splitting the base of pipe in four pieces and bending each piece out at a 90-deg. angle and lag screwing these ends to the floor. As soon as the operator releases his hold, the weight returns the spindle to starting position.



Safety device applied to a four-spindle horizontal wood boring machine

Metal-Covered Plywood

A LIGHT-WEIGHT metal-covered plywood, known as Armorply, is one of the new products of the United States Plywood Company, 103 Park avenue, New York. The plywood base is made up of a core of basswood, faced on each side with a thin sheet of Wisconsin birch. One or both sides may be covered with sheet metal. To meet different requirements the metal facing may be left extending beyond the plywood, bent over flush with the inner face or bent over the panel back with a lap 1 in. in width. Metal and wood are bonded together by a specially developed elastic glue.

For widths up to 36 in. the weights range from 1.46 lb. per sq. ft. for ¼ in. thick, faced with metal on one side, to 3.35 lb. for ¾ in. thick, faced with metal on two sides. Armorply is now available in sizes up to 80 in. by 190 in. Large size panels are made with a lock seam joint in the metal face.

Armorply may be faced with galvanized steel, Enduro stainless steel, Monel metal, chrome steels, copper, brass, etc. For special purposes it may also be combined with Celotex, Insulite, Balsa wood, or cork.

Due to its combination of light weight, great strength, long life and smooth, attractive surface, it has been found particularly useful as panelling for automotive trucks and trailers. In the railroad field it has also found a place in passenger-car construction, having been used on the Burlington high-speed, streamlined train, the Zephyr.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Brake Beam No. 3 in Place of No. 2 Plus—Rules 17 and 87

The Chicago, Rock Island & Pacific removed a No. 2 plus brake beam with broken support rod from a Great Northern car and replaced it with a No. 3 brake beam, rendering a charge of $3.50 and one hour labor on repair card. Defect card was not issued. Owners contended that such substitution constitutes improper repairs for which defect card should be issued and requested cancellation of entire charge. Being unable to arrive at a settlement, the case was submitted by mutual consent for decision. The Great Northern stated that the car referred to was stencilled for and actually was equipped with No. 2 plus brake beams. Reference was made to Rule 17, Section (e), paragraph 1, and contention made that brake beams must be replaced in kind. Reference was also made to third paragraph of Rule 87 which requires repairing line to attach a defect card for making improper repairs of owner's defects, or assume entire cost of such repairs by marking repair card "no bill." Cancellation of charges was asked for under Rule 87, paragraph 4, and Arbitration Case 1706 was quoted as parallel. The C.R.I. & P. stated that at the time repairs were made they did not have any No. 2 plus brake beams on hand and, in order not to make wrong repairs and apply brake beam of a class lower, a No. 3 brake beam was applied and charge confined to price of No. 2 plus brake beam. No defect card was applied, as it was not considered that a wrong repair had been made by substituting a No. 3 for a No. 2 plus beam, both being interchangeable and A.R.A. standards.

In decision rendered October 26, 1933, the Arbitration Committee stated: "The brake beam applied fulfilled the minimum dimensions for a No. 2 plus beam, as given in Rule 101, and charge was confined to cost of beam standard to car. Therefore, the contention of car owner is not sustained."—*Case No. 1736, Great Northern vs. C. R. I. & P.*

In the Back Shop and Enginehouse

Building Up Worn Main-Rod Front Ends

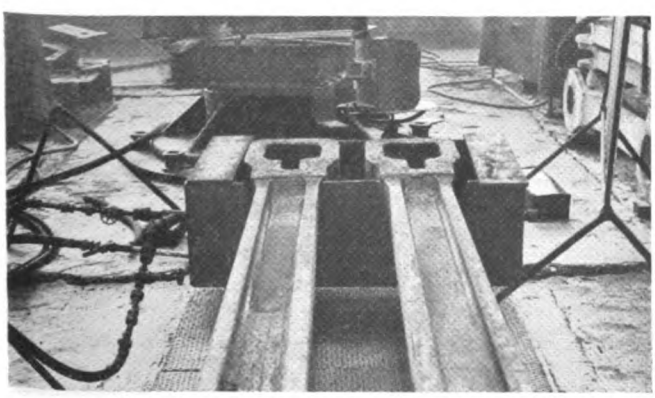
WHEN the sides of main-rod front ends become galled or badly worn, they are built up on the Illinois Central by the use of the electric process, a definite, carefully-developed procedure being followed to assure obtaining the desired results. As a matter of fact, this process has been followed at the Paducah, Ky., shops for a period of nearly two years and made possible a greatly increased service life of main rods without a failure of any kind.

The first operation consists of grinding the worn parts and the sides to be welded until all surface defects, checks and fractures are removed. The sides of the main-rod front ends are then etched with acid and carefully inspected by the engineer of tests, using a powerful magnifying glass, to make sure that all surface defects are removed. The formal approval of the engineer of tests is required before further reclamation work on the main rods is done.

The second operation consists of slowly preheating the rod ends to be welded in a charcoal furnace where the required temperature is maintained during the time of welding. Referring to the illustration, this furnace consists of a simple, rectangular, sheet-metal design, lined with fire brick and provided with connections to the shop air line for blowing purposes. The rods are usually welded, two at a time, the ends being inserted in the furnace at one side which is cut away to receive and support them flush with the top of the furnace. Cover plates are used at the ends and between the rods, not only to retain the heat but to serve as a protection to the welders. Portable vertical shields surround the furnace during the electric-welding operation as a protection to workmen employed in the immediate vicinity. A temperature of 600 to 800 deg. F. is maintained in this preheating furnace for all types of rods welded.

Both low-carbon and chrome-vanadium steel rods are reclaimed by this method, Hollop No. 250 shielded arc electrodes being used in the former case and No. 170-E electrodes in the latter case. Each layer of the welded material is thoroughly cleaned by chipping and sandblasting before application of a subsequent layer, and the operation is continued until the welding surface is ⅛ in. above the finished size. The rod ends are then heated to a temperature of 1,600 deg. F. in a pyrometer-equipped furnace, placed on a face plate and a heavy hand hammer and flatter used to smooth and pack the welded surface, after which it is ground and inspected for flaws.

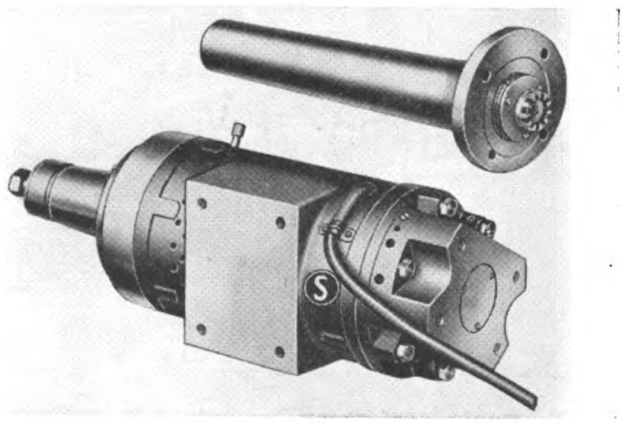
The rods are then placed on the table plate of another pyrometer-equipped heat-treating furnace for heat treatment, supported properly to prevent warping and, in the case of carbon steel rods, the furnace and rod temperature raised to 1,550 deg. F. The rods are then allowed to cool down in the furnace to 1,300 deg. F., being removed at that temperature and allowed to cool in the open air. In the case of the chrome-vanadium rods, they are heated to a temperature of 1,525 deg. F., removed from the furnace and cooled in the open air, then being returned to the furnace and heated to a temperature of 1,200 deg. F., after which they are cooled in the furnace to 800 deg. F. and finally cooled to atmospheric temperature in the open air. A final inspection and check for alinement is made before the rods are sent to the machine shop for fitting up.



Charcoal furnace used in preheating main-rod front ends prior to building up worn side faces by electric welding

Combination Angle Plate Grinder

THE Standard Electrical Tool Company, 1938 West Eighth street, Cincinnati, Ohio, has developed a new combination angle plate grinder. This machine is powered by a General Electric 3,600-r.p.m. alternating-current motor which may be of 3, 5 or 7½ hp. size. The motor shaft is fitted with two S K F ball bearings, while the grinding wheel spindle is equipped with three S K F ball bearings, two of them being located at the wheel end to take care of the end thrust. It can be furnished with solid spindle or with clutch arrangement so that the



This standard combination grinder is provided with attachment pads on side and end

short extension is interchangeable with the longer extension. It may also be obtained with vertical, or horizontal, or with both vertical and horizontal feeds. This is a versatile machine, as the pad on the back of the motor may be used for mounting on a boring mill, while the pad on the side of the motor housing is arranged for mounting on the rail of a planer. It can also be fitted with a plain angle plate for attaching to a lathe.

No. 2 High-Speed Turret Lathe

A NEW 1-in. bar capacity turret lathe capable of 1,480 r.p.m. and with an improved bar-feed mechanism is announced by The Warner & Swasey Company, Cleveland, Ohio. This turret lathe is equipped with a six-speed all-geared head with speed ranges from 67 to 740 r.p.m. up to from 134 to 1,480 r.p.m. A two-speed motor makes 12 speeds possible with a range from 67 to 1,480 r.p.m.

The entire head is anti-friction bearing equipped. All gears are of hardened alloy steel and have ground teeth for silent operation. The head has sufficient power for heavy-duty work with cemented tungsten carbide tools. A single pulley constant-speed drive makes the full horsepower available at all six speeds. The forward and reverse multiple disc-clutch has ample area to allow reversing even at high speeds. A four-to-one ratio high-low clutch makes possible the instant shifting from turning to threading or reaming speeds, or vice versa, without stopping the spindle. Lubrication of the entire head is by splash system. The spindle is mounted on double row precision Timken bearings at the front end and a preloaded precision straight-roller bearing in the rear. All other shafts run on roller bearings.

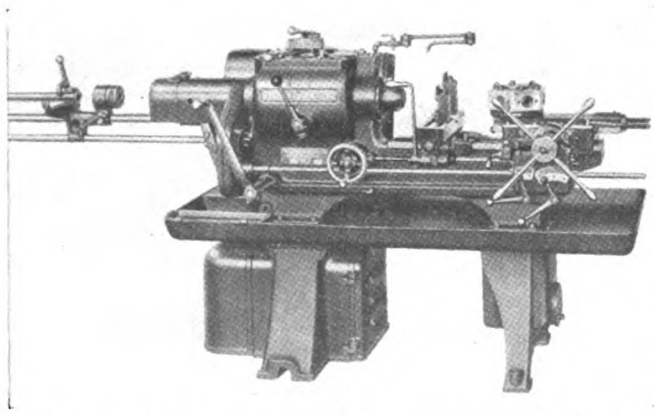
The new type automatic circumference binder ring, which permits the clamping and indexing of the hexagon turret by a rotation of the turnstile, is incorporated in this turret lathe. This is valuable in high-speed work where the reduction of the handling time becomes an item.

The high speeds and ease of operation make the turret lathe an efficient tool for very small work or for second-operation work. Cemented tungsten carbide tools may be used on cast iron, steel, non-ferrous metals or non-metallic materials.

A new combination friction finger and ratchet bar feed has been designed which speeds up the operation and provides for the safety of the operator. Bars up to 5/8-in. diameter are advanced with a friction finger lying immediately behind the collet inside the spindle and enclosed throughout their length. This prevents buckling or bending of the bar through centrifugal force, and thus protects the operator and eliminates vibration. The use of filler tubes assures balance at high speed by centering the bar in the spindle.

Bars above 5/8-in. diameter are fully enclosed at the rear end, being exposed only for the length of the ratchet feed stroke between the spindle end and the bar support tube. There is, of course, no danger of buckling in bars of this size when supported at both ends. By using the ratchet feed for the larger bars, it is possible to have a maximum 1-in. capacity with a spindle small enough in diameter to stand extremely high speeds.

Another feature of this machine lies in the possibility of arranging the cross slide as a lever feed or screw feed type, or a combination of the two, by simply substituting the required parts in the cross slide. The power feed is new and has been designed for continuous operation at high speeds. The initial reduction from the spindle is by V-belt. The first reduction gear, made of hardened alloy steel, has ground teeth to insure silent operation. The entire train is mounted on antifriction bearings and all apron gears are of hardened alloy steel. Lubrication is by grease, which cannot be readily washed away by the coolant. The pressure used to force grease into the bearing tends, at the same time, to force out foreign matter. The hardened worm runs in an oil bath and is completely shielded to prevent oil loss by centrifugal force. The six feeds for the hexagon turret range from .003 in. to .030 in. An option of two change gears will reduce the feeds by one-half.



Warner & Swasey No. 2 six-speed turret lathe

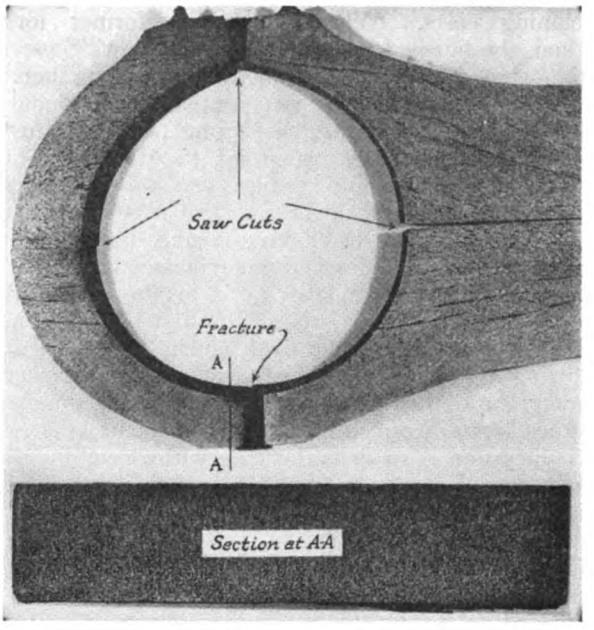
Forging Main-Rod Back Ends

IN studying the failures of locomotive main and side rods, it has been found in certain cases, particularly in failures of main-rod back ends, that the fractures (or breaks) occur at points where the work-flow lines or crystal forms in the steel lie at right angles to the axis of the rod proper. Expressed in another way, the service stresses are exerted in a direction in which the steel is least able to support such stresses, especially from a shock-resisting standpoint. It is generally recognized that the weakest direction in a forging or rolled section is transverse to the direction of maximum forging work; that is, there are decidedly lower physical characteristics in the transverse direction, including reduced tensile strength and especially ductility, as indicated by lower elongation and reduction of area and by lower shock resistance, as shown by Izod and Charpy tests.

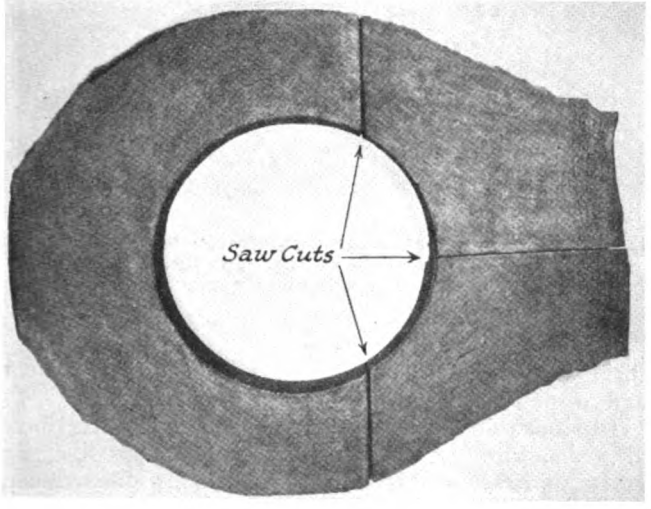
With the object of reducing the number of failures of this type, the Chicago, Rock Island & Pacific has worked out an improved method of forging rods, whereby the most advantageous disposition of the work-flow lines is attained and proper forging work provided throughout all sections of the rods. It has been general practice on this road, as well as on other roads and by forging companies, to use large size billets for main rods, such as 12 in. by 20 in. or 12 in. by 22 in., it being considered necessary under the ordinary forging practice to use this large size billet in order to make the large diameter back end, necessary since the floating bushing came into general use. This back end, using the large

billet, is forged solid and the crank pin hole cut out by machine or with a gas-cutting torch. Even starting with these large size billets, due to the large diameter of the back ends, very little reduction (in some cases, practically none) takes place across the vertical diameter, and, in consequence of this low reduction, proper forging work does not occur in the top and bottom sections and, in some cases, at the end of the rod. Another feature is that after forming the back end, using the large size billet, it is then necessary to reduce this section (240 sq. in.) to a cross-sectional area of approximately 20 sq. in. for a length of 9 to 11 ft. up to the front end of the rod.

To obtain a more advantageous disposition of the work-flow lines and also to reduce the necessity of drawing out such long lengths of large cross-section billets, the method to be described was developed which permits using billets of smaller cross section, such as 10 in. by 10 in., or smaller. These can be purchased at a lower base price and, even more important, a superior grade of steel is secured. For example, the common requirement in steel specifications that there be a minimum reduction of 3 to 1 or 4 to 1 from ingot cross section to billet cross section means that the steel maker is forged to start with a large ingot. Where smaller billets are required, the initial ingot can be smaller. This, in general, produces sounder, more dense steel, relatively freer from massive crystal forms, especially in the columnar zone and also freer of internal defects, such as unwelded gas pockets and non-metal inclusions locally segregated.

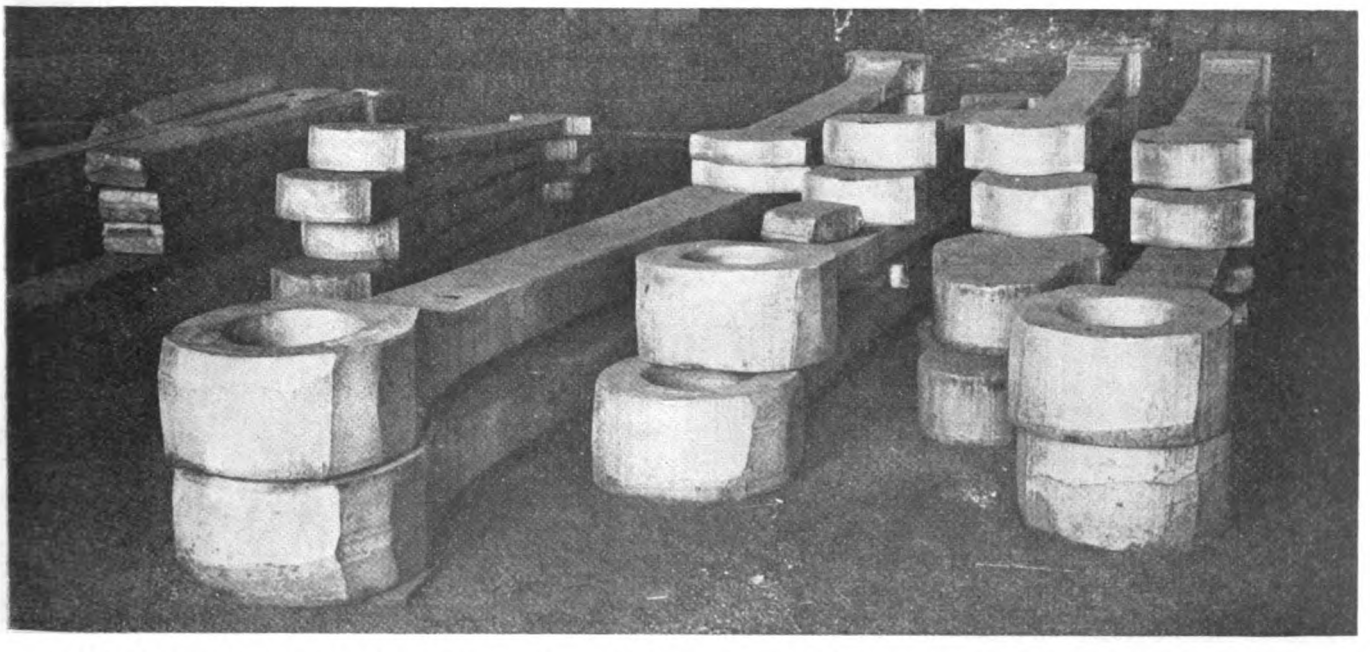


Deeply etched longitudinal and cross sections of failed main rod—Weakness indicated by the transverse direction of work-flow lines at the section where failure occurred



Moderately etched section of main-rod back end, forged by the improved method, which produces work-flow lines so placed as to contribute to maximum strength and reliability in the forging

The method of manufacturing main rods now followed at the Silvis (Ill.) shops of the Rock Island consists of punching and drifting the pin hole, forming the head in dies, and thus obtaining the best direction of the work-flow lines to resist service stresses at all points around the pin hole. In addition to other advantages, a substantial saving is brought about through less scrap material involved by making the rods from the smaller blooms, less scale loss due to heating smaller blooms, less loss in actual metal machined off, and, further, lower



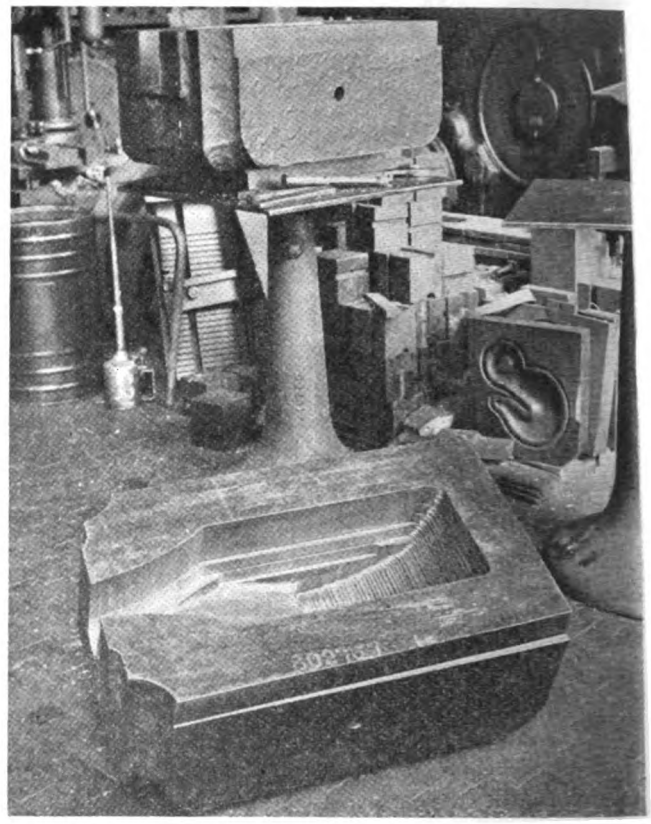
Main rods with back ends forged by piercing and drifting the pin holes to produce improved work-flow lines

machining costs. Whereas, by the former forging method, the finished rod weighed only about 35 per cent of the original billet, the new method of forging increases this to at least 50 or 60 per cent, and additional increases are anticipated as the forging process is further developed. As regards machining, the use of the head-forming dies materially reduces subsequent machine work on the back end of the rod, and it is felt that ultimately grinding will be about the only finishing operation necessary on the exterior surfaces.

In forging a main-rod back end by the new method, a 10-in. by 10-in. billet is used, the first operation being to pierce the head with an oval punch, 2 in. by 4½ in., following up with two more oval punches, larger in diameter, and then working the head to contour with hammer blows, a punch being inserted in the billet. The next operation is to drift the hole with one 9-in. round punch with hammer blows, followed by one 10½-in. round punch in the billet. The rod head is then finally shaped in the forming dies.

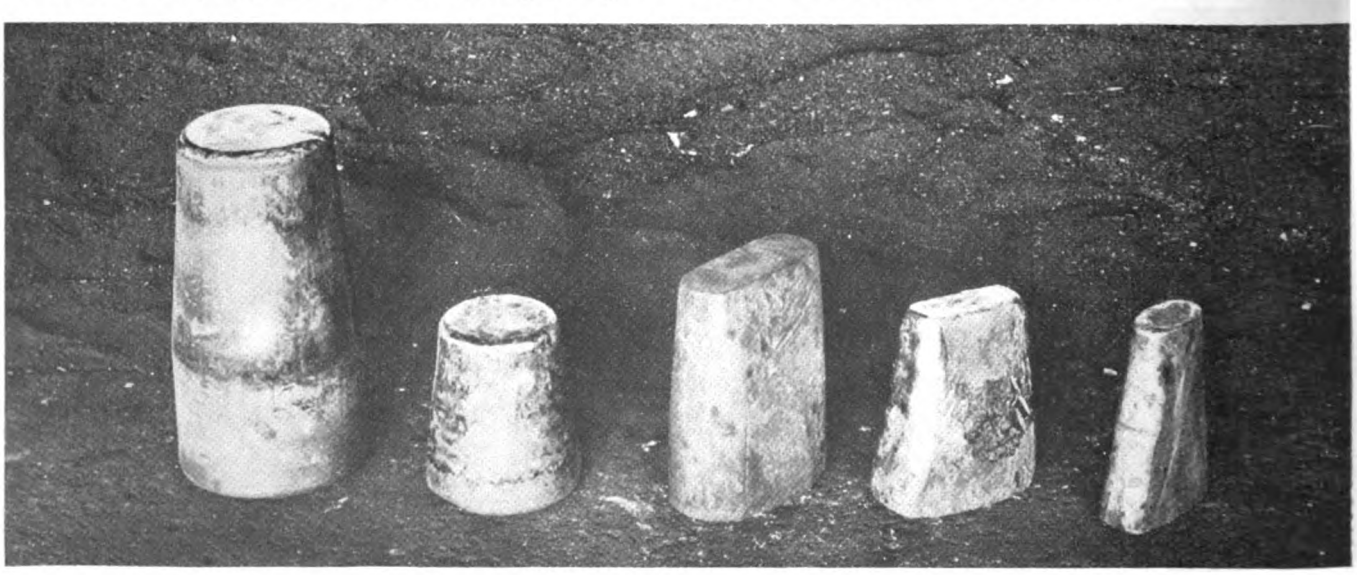
That the desired results are obtained in respect to the disposition of work-flow lines and more uniform working of all sections is indicated in the illustrations, which show deep etches of faces of vertical longitudinal cuts through the back ends of two main rods. A deep etch of a rod forged by former methods from a large-size bloom is shown in one of the illustrations. It will be noted that the work-flow lines run parallel in some sections to the axis of the rod but, at the top and bottom, the flow lines or crystal forms stand at an angle or perpendicular to the axis of the rod. This is the real reason that the rod failed in service, although it is true that the failure took place through the keeper bolt hole. It is conceded that improper location of this hole and improper workmanship in making the hole would be a factor in initiating a break at this point. However, in Rock Island experience, no breakage has occurred through this hole where the direction of the work-flow lines or crystal forms have been properly placed in respect to the direction of service stresses. An etch of a cross section at *AA* adjacent to this hole plainly shows crystal forms remaining in the same direction in which they froze in the ingot, the subsequent reduction by forging being not sufficient to displace these crystal forms and change the direction to form proper work-flow lines.

A representative etch of a rod made from the smaller billet by the improved method with the pin hole formed by piercing and drifting is shown in another illustration. It will be noted that a more uniform working took place through all sections and the work-flow lines run up to and around the crank pin hole.



Die used in the final forging operation on the main-rod back ends—View shows die in the tool-room before it was completely machined

It is not to be inferred that the Rock Island attributes all rod failures to improper direction of flow lines and crystal forms, as this is conceded to be only one of numerous influences contributing to such failures. It is felt, however, that if this factor is eliminated, the situation is improved to that extent, and by giving proper attention to providing generous fillets and rounded corners, assuring the proper location of oil and keeper bolt holes, eliminating all nicks and surface defects in so far as practicable, and smoothly polishing all surfaces, the service life is increased and liability of failure minimized.

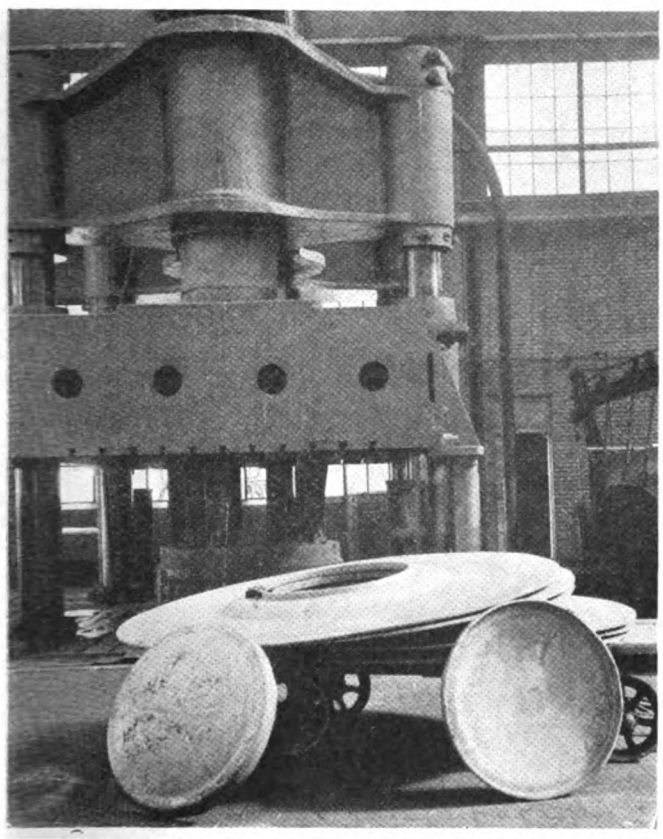


Elliptic piercing and round punches for forming crank-pin holes—Used in the order indicated from right to left

Making Boiler Front Rings and Doors

SOME difficulty has been experienced on the Illinois Central as well as other roads with cinder-cut boiler front rings and doors which wear thin and do not have the desired rigidity and length of service life. To meet this condition, it was decided on the I. C. to increase the thickness of these parts from ⅜ in. to ½ in.

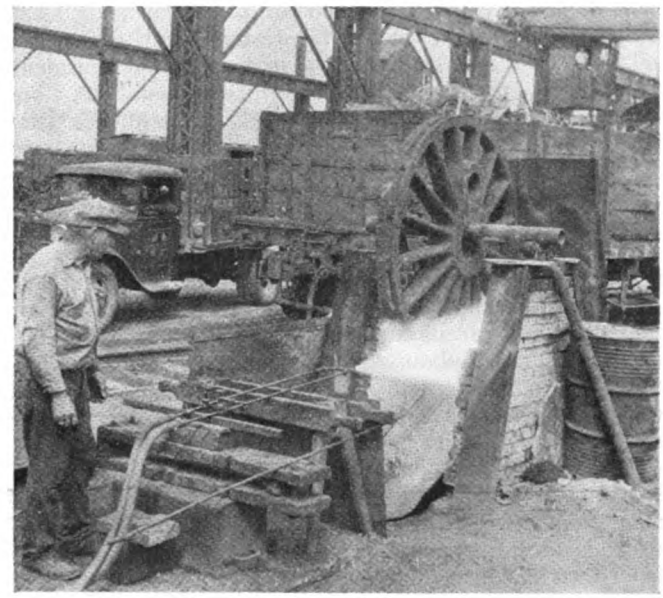
In making the heavier front rings and doors at the Paducah (Ky.) shop of the Illinois Central, ½-in. steel sheets of the desired size are cut to shape and formed in the Southwark 2,100-ton flanging press, illustrated. In the case of the boiler front rings, the circular door opening is cutout with an oxyacetylene torch and the ring formed hot in one operation of the flanging press. The front-end doors are also formed to the shape indicated and flanged in one operation of the press.



Southwark 2,100-ton flanging press used at Paducah shops for forming boiler front rings and doors

Removing Babbitt From Driving Wheels

A CONVENIENT and efficient method of removing babbitt from locomotive driving wheels before they are disposed of as scrap is shown in the illustration. It consists of two 2-in. by 10-in. channels formed to an A-shape, with the flanges extending inward to serve as a guide for the fire brick which are inserted and form the sides of the furnace. A diagonal side brace, consisting of a piece of steel tubing welded to the upper side of each A-frame and firmly anchored in the ground at the lower end, serves to stiffen the frame and add



Convenient method of removing babbitt from driving-wheel centers

rigidity to the structure. The flattened upper end of each A-frame serves as a support for a double roller truck side bearing which, in turn, supports a short horizontal tube provided to carry the wheel center. This tube is inserted through the axle fit of the wheel center and enables the wheel to be revolved easily, as required, in heating various sections of the counterweight and rim for melting out the babbitt.

In heating the wheel center, a special distillate oil-burning torch is used, as shown in the illustration. The flame is directed against the lower part of the driving-wheel rim where it extends down between the A-frames. As the babbitt melts out of the wheel, it falls onto a curved steel sheet which guides it into a suitable receptacle, or mold. The amount of babbitt removed varies, of course, with the size and type of wheel center, but averages about 700 lb. per wheel.

Metal Coating To Prevent Corrosion

SEVERAL years ago in an effort to reduce replacements and maintenance costs on metal parts the Western Union Telegraph Company tried to find some method of protection against corrosion which would be more permanent than that provided by paint or lacquer alone. In furtherance of this effort Dr. Leo P. Curtin, consulting chemist, was delegated to make a study of this problem.

As a result of this investigation there was developed a metal treatment that is simple to handle, inexpensive and positive in its action. The ingredients consist of a powder and a solvent used in water at a temperature of approximately 150 deg. F. This metal treatment has recently been made available to the trade under the name of "Loxal."

The treatment consists of dipping the metal parts to be treated into a solution made up of about 10 oz. of Loxal powder and 3 oz. of Loxal solvent per gallon of water. The parts to be treated are introduced into this solution in perforated iron baskets, racks or trays, and are held in this solution for a period of from one to five minutes and are then given a quick rinse in hot water, after

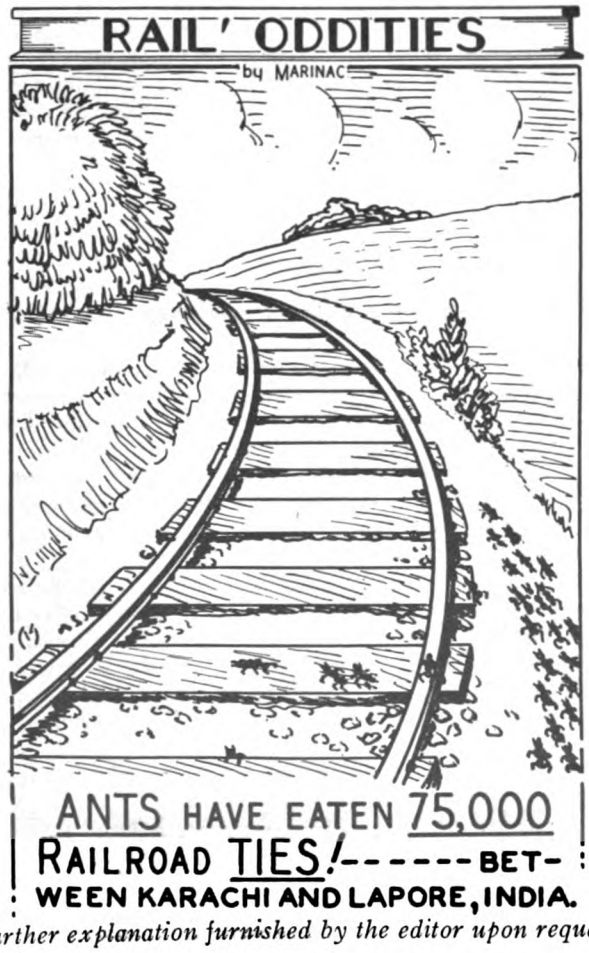
which they are dried in open air or a warm air blast. Little preparation is needed before treatment. Removing oil or grease and sometimes a brief pickling treatment, followed by rinsing in hot water usually suffices. The equipment required is inexpensive and requires practically no maintenance. A metal tank of requisite size, fitted with steam coils to heat the solution to 150 deg. F. and with facilities for filling with water and for handling the material to be treated, is all that is necessary.

Iron and steel parts, cleaned by ordinary materials, are extremely susceptible to rusting after treatment and must be lacquered or otherwise finished within a few hours. When metals are coated with Loxal, such parts may be stored without danger of rusting, until used or until it is convenient to apply the finishing coat. Loxal coating also acts as a bonding coat, to which the finishing coat of paint, lacquer or enamel tenaciously adheres.

It is applicable to practically all types of iron and steel surfaces. The carbon content of the steel has no appreciable effect in retarding the formation of the coating, and excellent results have been obtained on objects which have been spot-welded or which carry an oxidized film on the surface.

There is a large coverage per pound of material and no appreciable loss as a result of precipitated sludge in the work-tank, since the addition of Loxal solvent to the bath converts any sludge into a clear solution which automatically becomes the active coating ingredient. Iron equipment is not harmed by Loxal, and there is no danger of leaks occurring in iron tanks in which it is used. As no chemical incrustation forms on the heating coils, whether made of iron or brass, high heating efficiency is maintained.

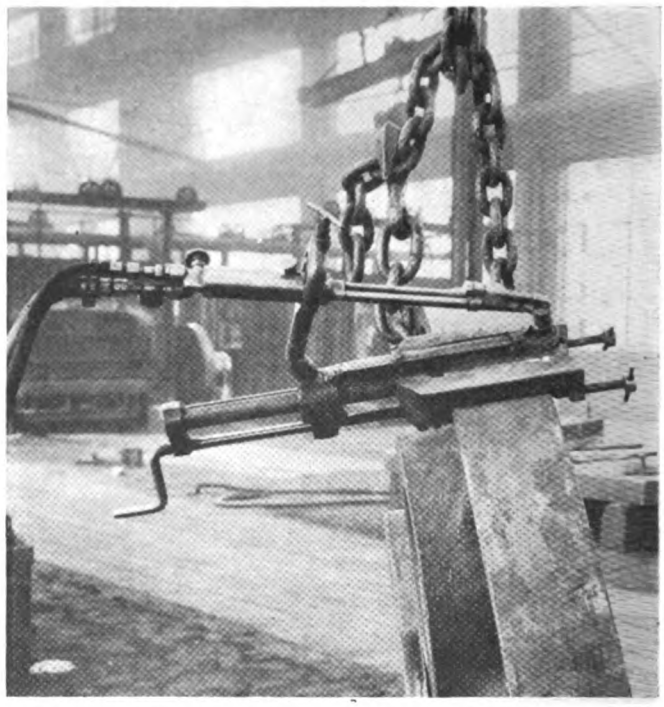
The material for this new process is being distributed by the Curtin-Howe Corporation, New York.



Further explanation furnished by the editor upon request.

Torch Guide for Cutting Wheel Rims

IN welding cast steel wheel centers with broken spokes, it is considered good practice to cut the wheel rims at one or more places to prevent the development of excessive internal stress due to expansion and contraction. In performing this operation at the Paducah (Ky.) shops of the Illinois Central an ordinary oxyacetylene cutting torch is used, being held in the simple guiding device, illustrated, to assure making a cut square across the rim of the wheel and in a radial direction. This device consists of a double-bar type bracket, capable of being secured to the rim of the wheel by hand screws and provided with a torch-holding fixture which moves back and forth over a suitable guiding bar under the control of a hand screw. This permits feeding the torch, with the point supported at the proper angle, slowly across the wheel rim. The general principle of the construction of the device is clearly indicated in the illustration.



Torch-holding fixture for use in cutting wheel-center rims prior to welding broken spokes

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RAILWAY NICKNAMES.—From all over the country they come, the railway nicknames. Culled from some 50 letters received are the following:

Lake Erie & Western	Leave Early & Walk
Zanesville & Western	Zealous & Willing
Toronto, Hamilton & Buffalo	To Hell & Back
Susquehanna, Bloomsbury & Berwick	Sweet Bye & Bye
Cincinnati, Hamilton & Dayton	Charges High & Damned Rough Riding
Hoosac Tunnel & Wilmington	Hoot, Toot & Whistle
Hoosac Tunnel & Wilmington	Hot, Tired & Weary
Live Oak, Perry & Gulf	Lean Over, Push & Grunt
Live Oak, Perry & Gulf	Live On Peas & Grits
Manchester, Dorset & Granville	Mud, Dirt & Gravel
Baltimore & Ohio	Best & Only
Green Bay & Western	Grab Baggage & Walk

Among the Clubs and Associations

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—Draft Gears and Snubbers will be discussed by a representative of the Cardwell-Westinghouse Company at the meeting of the Club on the morning of November 15 at the Ansley Hotel, Atlanta, Ga. Election of officers will also take place.

INTERNATIONAL ACETYLENE ASSOCIATION.—The thirty-fifth annual convention of the Association will be held at the William Penn Hotel, Pittsburgh, Pa., November 14, 15 and 16. At a transportation session on Friday morning, November 16, G. O. Hoglund, supervisor of welding, Aluminum Company of America, will present a paper on Construction of Transportation Vehicles by Welding. Another paper on the Maintenance of Railroad Rolling Stock will be presented by D. C. Reid, general superintendent of motive power, Boston & Maine. Other papers to be presented during the convention will discuss oxy-acetylene cutting with particular reference to steel mill applications; metallurgical aspects of the oxy-acetylene process; pipe welding and testing, and education and safety in welding.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—The annual meeting held on October 8 at The La Salle hotel, Chicago, was presided over by President F. L. Kartheiser, mechanical inspector, Chicago, Burlington & Quincy, who reported 800 membership renewals and the addition of 1,400 new members during the past year, bringing the present membership of the association up to 2,604 as of September 30. ¶ Immediately after the business session, the following officers were elected for the ensuing year: President, E. U. Mazurette, car foreman, Grand Trunk Western; first vice-president, C. O. Young, chief clerk to superintendent of car department, Illinois Central; second vice-president, J. S. Acworth, supervisor of equipment, General American Car Company. C. J. Nelson, superintendent of interchange, The Chicago Car Interchange Bureau, and G. K. Oliver, assistant passenger car foreman, Baltimore & Ohio Chicago Terminal, were re-elected treasurer and secretary, respectively.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The Railroad Division of the Society will hold two sessions at the annual meeting which will be held at the Engineering Societies building, 29 West Thirty-Ninth street, New York, December 3-7. The first session of the Division will be at 9:30 a.m., Tuesday, December 4, when two papers will be presented—Tractive Power of Steam Locomotives (Locomotive Ratios, II), by A. I. Lipetz, consulting engineer, American Locomotive Company, and Locomotive Tractive Effort in Relation to Speed and Steam Supply, by E. J. Young, research professor, Railway Mechanical Engineering, University of Illinois, and C. P. Pei, New York Air Brake Company. The second session will be at 2 p.m. on the same day when the papers for discussion will be Draft Gear Action in Long Trains, by O. R. Wikander, mechanical engineer, Ring Spring Department, Edgewater Steel Company, and Development of Steel for Application to Railroad Equipment, by A. F. Stuebing, railroad mechanical engineer, United States Steel Corporation. A progress report on railway mechanical engineering during 1934 will also be presented at one of these sessions by a committee of the Railroad Division.

WESTERN RAILWAY CLUB.—The first fall meeting of the Club was held at the Hotel Sherman, Chicago, Monday evening, October 15, over 300 members and guests being present to hear the paper on "Rail Transportation Problems and Solutions," presented by W. F. Thiehoff, general manager, C., B. & Q. Calling attention to the reduction in Class I railway operating revenues of 50 per cent from 1929 to 1933 and the reduction of over 65 per cent in expenditures for materials and supplies during the same period, Mr. Thiehoff said that, while the general recession in business has undoubtedly had its effect, the primary cause of the reductions mentioned is the increased use of private automobiles, motor buses, trucks, airplanes, waterways and pipe lines. ¶ In connection with the question of regulating non-rail transportation media, Mr. Thiehoff said: "These forms of transportation, developed during recent years, are not subjected to regulation as to rates, schedules, etc., as are the railroads. They have no investment in right-of-way, tracks, bridges, etc., pay taxes only on the value of equipment owned and on such terminal facilities as are owned by the operating companies. They do not pay the so-called standard wages under contract as do the railroads; are not subject to the same hours-of-service laws, safety laws, or rulings of the Interstate Commerce Commission; in fact, the owner or operator of a truck or bus may operate on the streets and highways subject to no restriction except the laws and rulings that apply to individuals. There can be 100 trucks or buses operated by as many owners as individuals if permit is obtained and license procured, each having a different rate. Even though operated over competitive routes and different states, they are not required to file tariffs, rates or schedules with the Interstate Commerce Commission." ¶ In discussion subsequent to the presentation of Mr. Thiehoff's paper, a number of members emphasized the need for constructive regulation of all forms of transportation, and the consensus was that little real permanent improvement in railway conditions can be expected until this regulation is initiated and made effective.

Directory

The following list gives names of Secretaries, dates of next regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, c/o Westinghouse Air Brake Company, Thirty-fourth floor, Empire State Bldg., New York. 1935 meeting tentatively planned for May 2 to 4, inclusive, Hotel Sherman, Chicago.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—Division V.—MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASE AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, N. W., Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago. 1935 meeting tentatively planned for May 6, 7 and 8, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York. Annual meeting December 3-7, Engineering Societies building, New York.

RAILROAD DIVISION.—Marion B. Richardson, Room 332, 30 Church street, New York.

MACHINE SHOP PRACTICE DIVISION.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—Edgar J. Kates, 1350 Broadway, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Jos. A. Andreucetti, C. & N. W., 1519 Daily News Building, 400 W. Madison St., Chicago, Ill. Annual meeting, October 4-5, 1934, Hotel Sherman, Chicago, Ill. Exhibit by Railway Electrical Supply Manufacturers' Association.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, 7926 South Morgan street, Chicago. 1935 meeting tentatively planned for May 2 to 4, inclusive, Hotel Sherman, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, La Salle Hotel, Chicago, Ill.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month except June, July and August at Hotel Statler, Buffalo.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich. 1935 meeting tentatively planned for May 6, 7 and 8, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago. 1935 meeting tentatively planned for May 6, 7 and 8, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha street, Winona, Minn. 1935 meeting tentatively planned for May 2 to 4, inclusive, Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. 1935 meeting tentatively planned for May 6, 7 and 8, Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—Ralph D. Stewart, 21 Sherrard avenue, Greenville, Pa Regular meeting third Thursday in month except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1941 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TORONTO RAILWAY CLUB.—N. A. Walford, district supervisor car service, Canadian National, Toronto, Ont. Meetings first Friday of each month except June, July, August and September.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio. Annual meeting tentatively planned for May 2 to 4, 1935, Hotel Sherman, Chicago.

WESTERN RAILWAY CLUB.—C. L. Emerson, 822 Straus building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

NEWS

THE ILLINOIS CENTRAL has placed on trial in steam train service between Chicago and Urbana, Ill., an all aluminum observation coach built by the Pullman Car & Manufacturing Corporation and displayed at A Century of Progress last year.

P. W. A. Loans to Railroads

THE CHICAGO & NORTH WESTERN has applied to the Public Works Administration for a loan of $5,650,557 for maintenance and equipment work, including heavy repairs to 160 locomotives at an estimated cost of $1,192,500, general overhauling and modernizing of 38 steel coaches, $379,067, installing air conditioning equipment in 6 steel dining cars, 19 steel parlor cars, and 20 steel lounge cars, $358,990, and general maintenance work on roadway, structures and equipment, $3,720,000.

Association of American Railroads Formally Organized

The board of directors of the Association of American Railroads met in New York on October 12 and declared the plan for the formation of the new association, which succeeds the Association of Railway Executives and the American Railway Association, in effect as of that date. Formal written assents to the plan, which is regarded by the railroad executives who formulated the plan as "a concerted effort to protect and advance the railroad industry under private ownership and management to enable them better to handle their own affairs on a permanent basis, as well as to co-operate more effectively with the government in constructively working out a program in the interest of the owners of the railroad properties, their employees, and the public," had been received from 88 railroads or systems, representing 247,048 miles of railroad. An executive committee was elected with J. J. Pelley, president and chairman of the board chairman ex-officio and with the following additional members: Daniel Willard, president, Baltimore & Ohio; F. E. Williamson, president, New York Central; J. J. Bernet, president, Chesapeake & Ohio and Pere Marquette; C. R. Gray, president, Union Pacific, and H. A. Scandrett, president, Chicago, Milwaukee, St. Paul & Pacific.

On the board of directors are: M. W. Clement, vice president, Pennsylvania (succeeding General W. W. Atterbury, president, Pennsylvania); J. J. Bernet, president, Chesapeake & Ohio; L. W. Baldwin, trustee, Missouri Pacific Lines; W. R. Cole, president, Louisville & Nashville; L. A. Downs, president, Illinois Central System; C. R. Gray, president, Union Pacific System; Hale Holden, chairman, Southern Pacific Lines; Fairfax Harrison, president, Southern Railway System; E. S. French, president, Boston & Maine (succeeding J. J. Pelley, president, New York, New Haven & Hartford); H. A. Scandrett, president, Chicago, Milwaukee, St. Paul & Pacific; F. W. Sargent, president, Chicago & North Western System; Daniel Willard, president, Baltimore & Ohio; F. E. Williamson, president, New York Central Lines, and Ralph Budd, president, Chicago, Burlington & Quincy.

The board will meet regularly on the third Friday of each month. The main office will be in Washington and a branch office will be maintained at Chicago but the New York office of the two old associations may be discontinued.

Formation of the new association marks the retirement of Richard H. Aishton, chairman of the Association of Railway Executives and chairman of the board of the American Railway Association, after 15 years of continuous service with the American Railway Association and its predecessor, the American Railroad Association, which took its place during the period of federal control, although it is understood that some plan may be arranged to retain his services in an advisory capacity. Mr. Aishton, who is now 74, had long sought to be relieved of active duty and on April 1, 1933, he tendered his resignation as president of the A. R. A.

New Equipment

CAR ORDERS

Road	No. of cars	Type of car	Builder
Corn products refining Co.	75	8,000-gal. tank	Gen. Amer. Trans. Corp.
U. S. Dept. Interior	2	4-wheel 50-ton flat	American Car & Fdry. Co.

CAR INQUIRIES

Anglo Mexican Petroleum Corp.	12[1]	40-ton flat	.....
Lehigh Navigation Coal Co.	3	Air-dump (30 cu. yd.)	.....
Lehigh Valley	250[3]	50-ft. mill type gondolas	.....
National Rys. of Mexico	1,000	40-ton box	.....

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of locomotive	Builder
Chesapeake & Ohio	3	Pusher (electric)	Atlas Car & Mfg. Co.
C. M. St. P. & P.	2	Streamlined	American Loco. Co.
Nat'l Rys. of Colombia	1	2-8-8-2 oil burner	Baldwin Loco. Works

LOCOMOTIVE INQUIRIES

A. T. & S. F.	1[1]	3,600-hp. Diesel-elec. (Gen. Motors)	.....
C. & I. M.	2[1]	0-8-0	.....
Lehigh Valley	3[3]	Diesel-elec. (600 to 800 hp.)	.....

MISCELLANEOUS ORDERS

Road	No. units	Type of equip.	For use on	Order placed with
A. T. & S. F.	80[2]	Steam eject. air-co-dition. equip.	.....	Safety Car Htg. & Ltg. Co.
B. & M.[4]	10	Feedwater heaters	locos. under construc.	J. S. Coffin, Jr., Co.
	10	Valve pilots	locos. under construc.	Valve Pilot Corp.
	10	Engine-truck bearings	locos. under construc.	Timken Roller Bearing Co.
B. & O.	8-car	Streamlined train	Bearings and boxes	Timken Roller Bearing Co.
	8-car	Streamlined train	Journal boxes	Hyatt Roller Bearing Co.
C. B. & Q.	2	Streamlined trains	Bearings and boxes	Timken Roller Bearing Co.

[1] Contemplated only.
[2] Thirty railroad owned cars; 50 pullman.
[3] Part of equipment to be purchased with P.W.A. allotment.
[4] Two self-propelled coaches being built for the B. & M. by the St. Louis Car Company will also be mounted on Timken roller bearings and boxes.

but was elected to the new position of chairman of the board, while M. J. Gormley was elected president. He had been chairman of the executive committee of the Association of Railway Executives since 1924. He had become president of the American Railway Association in 1920, after his retirement from active railroad management, as the first to hold that position who was not an officer of an individual railroad. Prior to that time the office of president of the A. R. A. had been held for a year at a time by one of the railroad executives who retained his office on the individual road. In 1929 he also became general chairman of the Presidents' Conference Committee on Federal Valuation.

Dr. Calvin W. Rice Dies

DR. CALVIN WINSOR RICE, for the past 28 years secretary of the American Society of Mechanical Engineers, died in New York on Tuesday, October 2.

Doctor Rice was born in Winchester, Mass., November 4, 1868, and was graduated from Massachusetts Institute of Technology in 1890. In 1926 he was given an honorary doctor's degree in engineering by the Technische Hochschule in Darmstadt, Germany. He was also the recipient of the Knight Cross of the Order of the White Lion from Czechoslovakia, and a medal of honor from the Verein Deutscher Ingenieure. The citation in the latter case included not only his services to technical, scientific achievement, but "particularly in promoting mutual international interests of engineers of the entire world."

His early experience after leaving college was largely in the electrical field. In recent years he was active in the promotion and upbuilding of the New York Museum of Science and Industry, and he also did much to stimulate interest in similar museums elsewhere.

U. P. Second High-Speed Train

THE six-car high-speed train of the Union Pacific which traveled from Los Angeles, Cal., to New York—3,259 miles—in 56 hrs. 55 min. from October 22 to October 25, was built by the Pullman Car & Manufacturing Company. It is the first Pullman-equipped streamlined train to be placed in service in this country.

Aluminum-alloy construction is used throughout in the train, with the exception of the power plant, bolsters and end sills, and steel trucks, and the same general principles of design are followed as in the case of the first U. P. three-car high-speed train. It differs primarily by the inclusion of sleeping cars, Diesel-engine drive and all auxiliary equipment mounted in a single power car; welded high-tensile steel trucks with clasp brakes; Pullman air-conditioning system with Frigidaire cooling units; improvements in certain details of structural design, including the articulated joints; and the provision of double windows, luggage racks and other additional interior equipment. The new train is 376 ft. long and weighs 210 tons, including all equipment, fuel, water, etc., which may be compared with an equivalent conventional train weight of about 700 tons.

The first car of the train, 48 ft. long, is devoted entirely to the power plant and auxiliaries. The second car is 64 ft. long and has 33 ft. for mail purposes, the balance of the car being utilized for a baggage compartment, and for the train-heating and air-conditioning equipment. The third and fourth cars are 64-ft. 24-passenger Pullman sleepers, with 10 sections, one compartment and one bedroom per car. The fifth car, also 64 ft. long, is equipped with 8 sections, one compartment and one bedroom, and has accommodations for 20 passengers. The sixth, or rear-end, car is practically 72 ft. long, being a 56-passenger coach, with a buffet in the rear end for serving light meals to passengers in their seats in the coach and in the Pullman sleepers. The total passenger-carrying capacity of the train is 124.

Power is supplied by a Winton 900-hp., 12-cylinder, two-cycle, V-type, Diesel engine, the first of its type to be used in American railroad passenger service. With 8-in. by 10-in. cylinders, the engine is designed to develop 900 hp. at 750 r.p.m., which may be compared with 600 hp. at 1200 r.p.m. developed by the distillate-burning engine installed on the first U. P. high-speed train. The Diesel engine proper is 20 ft. in overall length and weighs 18,000 lb. The main generator weighs 11,700 lb., and the driving motors 26,400 lb. The weight of the entire power plant, including engine, generator, motors, auxiliary engines, generator sets, pumps, radiators, air compressors, etc., is approximately 79,000 lb.

The power car, fully equipped, weighs 163,040 lb., or 81,800 lb. on the front truck and 81,240 lb. on the second truck.

The air-brake equipment for the train was especially designed and built by the New York Air Brake Company and features the use of the Decelakron control which is designed to assure stopping from exceptionally high speeds within the same or shorter distances than are now common practice with conventional steam trains.

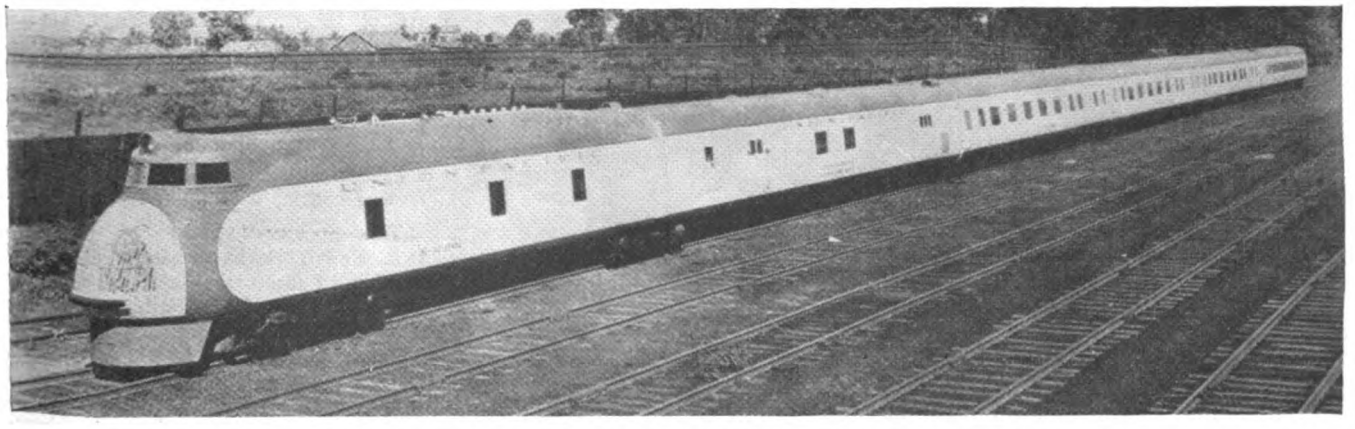
The actual schedule of the train on the trans-continental run, together with the mileages, running time and average speeds, is shown in the accompanying table. The elapsed time from Los Angeles to La Salle street station, Chicago, was 38 hrs. 48 min. and the total elapsed time from Los Angeles to New York 56 hrs. 55 min.

The route of the train was over the Union Pacific from Los Angeles to Omaha, the Chicago & North Western from Omaha to Chicago, and the New York Central from Chicago to New York.

On the entire run the train consumed 2,000 gallons of fuel oil at a total cost for fuel alone of $80. Stops for fuel were at Salt Lake City, Omaha and Chicago.

Trans-continental Schedule of Union Pacific Second High-Speed Train

		Mileage Between stations	Mileage Total	Time		Running time Hr.	Running time Min.	Avg. speed M.P.H.
Oct. 22	Los Angeles	0	0	Lv. 10:00 p.m.,	P.S.T.			
Oct. 23	Salt Lake City	784	784	Ar. 1:35 p.m. Lv. 2:00 p.m.	M.S.T.	14	35	53.6
Oct. 23	Cheyenne	519	1,303	Ar. 10:45 p.m. Lv. 10:55 p.m.	M.S.T.	8	45	59.2
Oct. 24	Omaha	507	1,810	Ar. 6:20 a.m. Lv. 6:30 p.m.	C.S.T.	6	25	79.0
Oct. 24	Chicago (La Salle Street Station)	488	2,298	Ar. 2:48 p.m. Lv. 3:30 p.m.	C.S.T.	8	18	58.6
Oct. 25	New York (Grand Central Ter.)	961	3,259	Ar. 9:55 a.m.,	E.S.T.	17	25	55.0



Union Pacific streamlined train which holds trans-continental speed record

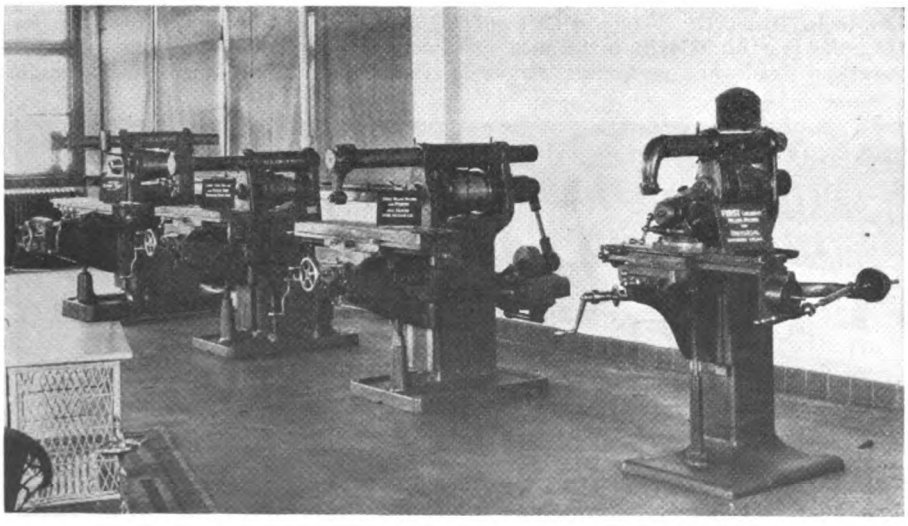
Cincinnati Milling and Grinders Celebrates Fiftieth Anniversary

DURING the week of October 8 to 14 the Cincinnati Milling Machine and Cincinnati Grinders, Inc., threw open the doors of its plants at Oakley, Cincinnati, Ohio, to welcome visitors from the automotive, industrial and railroad fields in celebration of the fiftieth anniversary of the company. Formed in 1884 as the Cincinnati Screw & Tap Company, the original plant was handicapped by the lack of a machine for fluting taps and a small milling machine was designed and built for this purpose. It was not long before neighborhood shops were buying the new Cincinnati miller and in 1889 the company was renamed the Cincinnati Milling Machine Company and henceforth devoted the major part of its efforts to the manufacture of milling machines and cutter grinders. The company's interests were centered primarily in the milling machine field until 1922 when it acquired the Cincinnati Grinding Machine Company and at about that time it brought centerless grinding into prominence.

The exhibit during the anniversary week afforded an opportunity to the many visitors not only to see, at first hand, the numerous and varied operations involved in the development and manufacture of milling and grinding machines and the more recent hydraulic broaching machines, but also to see these machines in actual operation on production work. One of the interesting features of the exhibit was the historical display of milling and grinding machines which gave an opportunity to study closely the progress that has been made in the development of these machines over a period of fifty years. This display enabled the visitor to see, step by step, the major events in the history of the miller—from the first machine with the original tubular section overarm, cone-pulley-driven spindle and hand feeds to the later designs with the universal dividing heads, power traverse and automatic control of table and spindle movements. Later came the introduction of the rectangular section overarm, square-gibbed bearings, power rapid traverse, intermittent feed, feed changes from the front, complete directional control from the front and rear with independent reverse to all table movements, sliding gear mechanisms for drive and feed boxes, and centralized lubrication. Recent years have witnessed the application of anti-friction bearings and enclosed motor drives and finally the Hydromatic and the high-speed, dial type milling machines designed to make possible the full utilization of the advantages of the new cutting alloys.

In the grinding field the exhibits ranged from the early cutter grinders to the more modern centerless grinders introduced in 1922 which development culminated in the new lapping machines which make possible tolerances of .00005 in. in diameter and .000025 in. in straightness and roundness.

In addition to the display of Cincinnati machines there was an exhibit of internal and rotary grinders manufactured by the Heald Machine Co., Worcester, Mass.



A group of old milling machines at the Cincinnati anniversary exhibit—The one at the right is one of the first machines built almost 50 years ago

Supply Trade Notes

LAWRENCE A. ROWE has been appointed special representative of the MacLean-Fogg Lock Nut Company, Chicago, with headquarters at Chicago.

H. A. STEVENSON has been appointed Loadmaster distributor for the Bucyrus-Erie Company, South Milwaukee, Wis., with headquarters at Detroit, Mich.

R. R. LALLY, who has been for several years manager of sales at New York for the Globe Steel Tubes Company, Milwaukee, Wis., has been elected vice-president in charge of eastern sales.

THE EQUIPMENT SPECIALTIES COMPANY, Chicago, has taken over the sale of the Nystrom divided basket bunker for refrigerator cars and the Nystrom rak-brace, a refrigerator car floor rack holder.

WILLIAM E. S. DYER has been elected president of the Edge Moor Iron Company, Edge Moore, Del. Mr. Dyer has been actively engaged in the consulting engineering field for nearly 30 years.

THE HOWARD P. COOK COMPANY, 945 Main street, Bridgeport, Conn., and 140 South Dearborn street, Chicago, has taken over the entire sales to the railroad trade of Jenkins tape, manufactured by Jenkins Bros., Bridgeport.

THE CARBOLOY COMPANY, INC., formerly at 2481 East Grand Boulevard, Detroit, Mich., has moved its general offices, Detroit district office and main manufacturing plant to 2985 East Jefferson Avenue, Detroit.

F. F. SEEBURGER has been appointed western manager for the Railroad Accessories Corporation, New York. Mr. Seeburger has acted as sales representative of the Ohio Brass Company during the past ten years.

THE CARBONDALE MACHINE COMPANY, Carbondale, Pa., has consolidated its interests in the general refrigeration field with those of the Worthington Pump & Machinery Corporation, Harrison, N. J., and will operate in future as the Carbondale Machine Corporation, Harrison.

HAROLD SMITH has been elected vice-president of the Westinghouse Electric International Company. Mr. Smith's new duties are in addition to those of his position as vice-president of the Westinghouse Electric & Manufacturing Company, with headquarters at New York.

W. A. NUGENT, who has been with the Independent Pneumatic Tool Company, Chicago, for 20 years, serving recently as sales manager, has been elected vice-president in charge of sales and Neil C. Hurley, Jr., in charge of the distribution of the company's electric tools, has been elected secretary, both with headquarters at Chicago.

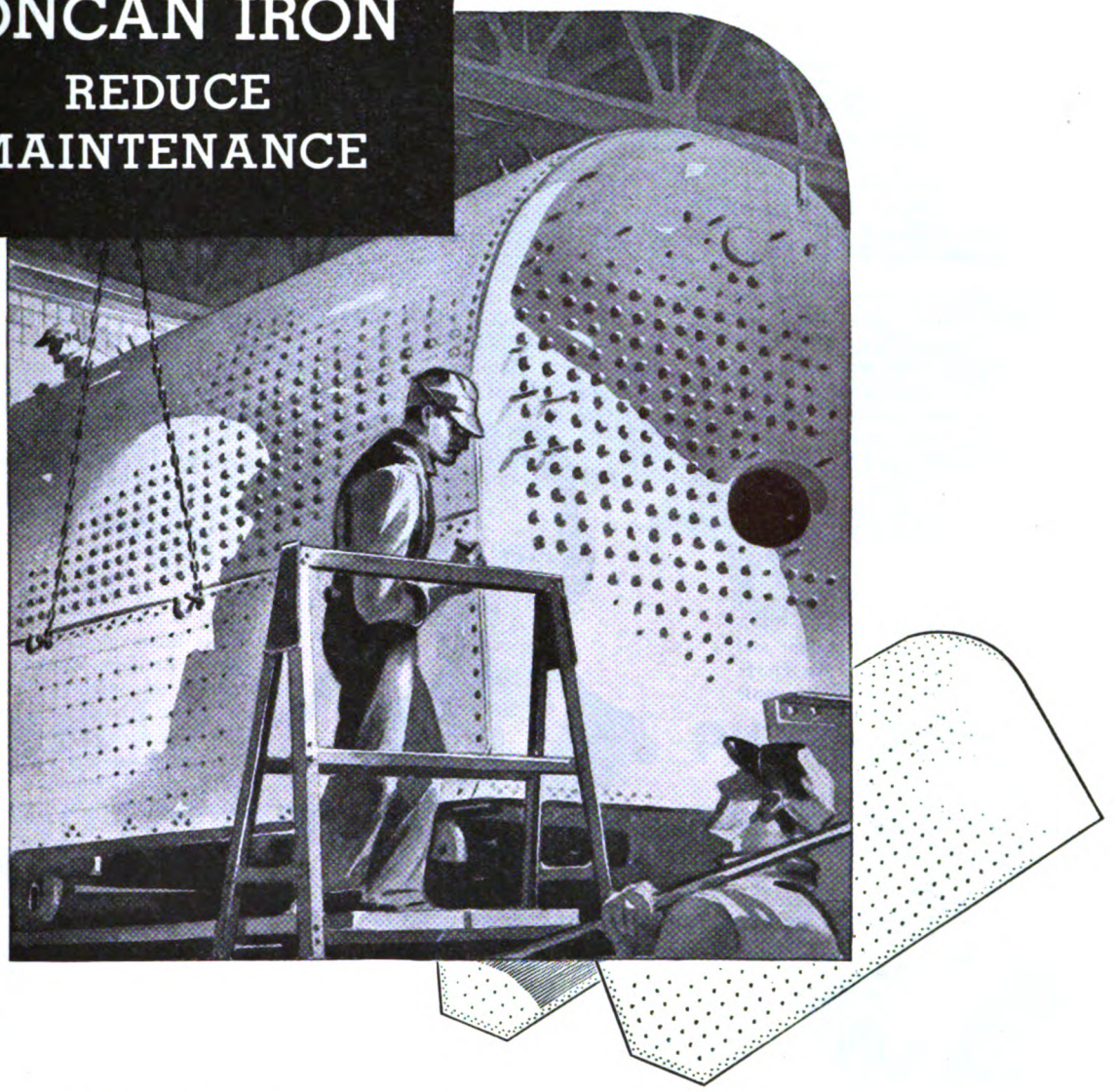
THE TIMKEN ROLLER BEARING COMPANY, Canton, Ohio, was awarded first place for the most effectively conceived and executed industrial advertising campaign of the year in the Tool and Equipment Division of the National Industrial Advertisers Association at the annual convention held in Cincinnati, Ohio, September 18, 19 and 20.

DANIEL B. WORTH, chief engineer of the Whitcomb Locomotive Company, Rochelle, Ill., has joined the engineering department of the Baldwin Locomotive Works, Philadelphia, Pa., where he will be identified with the engineering of Baldwin and Whitcomb electric and internal combustion locomotives. Edward P. Hachtel, Whitcomb production engineer, remains at Rochelle where he will be in charge of inspection and will provide engineering contact with the Whitcomb shops.

THE SOCONY-VACUUM OIL COMPANY, INC., New York, has organized a Railroad division to direct the sales of petroleum products in that field. Railroad sales, under this new arrangement, will be under the general direction of P. M. Gordon, manager, Industrial Lubrication division, who will be assisted by Earle Welborn. In the eastern field the sales and engineer-

(Continued on next left-hand page)

Firebox Sheets of
TONCAN IRON
REDUCE MAINTENANCE



"Double the life of ordinary steel firebox sheets" has been the experience of many railroads using Toncan Iron. « « « Because of their superior resistance to chloride, sulphide and oxygenated water corrosion Toncan Iron firebox sheets last longer. « « « Toncan Iron also shows an exceptional ability to absorb breathing strains because of its uniform physical properties gained by a uniform chemical make-up. Less uniform materials must relieve such strains with resulting fire-cracking. Toncan Iron eliminates this local breaking. « « « Toncan Iron has proved its ability to lengthen the life of locomotive fireboxes. Specify it for repairs.

Toncan Iron Boiler Tubes Pipe Plates Culverts Rivets Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel . . . The Birdsboro Steel Foundry & Machine Company of Birdsboro, Pa. has manufactured and is prepared to supply under license, Toncan Copper Molybdenum Iron castings for locomotives

REG. U.S. PAT. OFF. TONCAN COPPER MO-LYB-DEN-UM IRON

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES YOUNGSTOWN, OHIO
Reg. U. S. Pat. Off.

ing organization will be headed by R. R. Vinnedge with office at 26 Broadway, New York City. John E. Ferry, at Chicago, will be in charge of the company's railroad business in the middle and far West.

THE SHIPPERS' CAR LINE CORPORATION, the American Welding Company and the Acme Tank Car Corporation, subsidiaries of the American Car & Foundry Company, at recent special meetings of their respective boards of directors, each elected the following officers: G. R. Scanland, chairman of the executive committee, succeeding William M. Hager, and Robert Rogers, president to succeed R. H. Davenport, both with headquarters at New York.

V. L. CONLEY, assistant district manager of the Cleveland (Ohio) sales district of the American Rolling Mill Company, Middletown, Ohio, has been transferred to the Pittsburgh (Pa.) district as assistant district manager in charge of a new sales office opened in 17 Court Street building, Buffalo, N. Y. This office will have charge of all the territory in New York State from Utica west. A. W. Bryant, with headquarters at Rochester, N. Y., will assist Mr. Conley.

STANTON HERTZ, general sales manager of the Copperweld Steel Company, Glassport, Pa., has been appointed vice-president and chief engineer of that company. Mr. Hertz was graduated from Alabama Polytechnic



Stanton Hertz

Institute in 1911. He served with the Westinghouse Electric & Manufacturing Company for several years and with the Electrical Engineering & Manfacturing Company. During the war Mr. Hertz served overseas as first lieutenant, 56th Engineers regiment. For the past 14 years he has been with the Copperweld Steel Company, starting as electrical engineer, and in 1927 he was appointed general sales manager.

R. J. KNAPP has been appointed representative of the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company, in charge of its Denver, Colo., office, to succeed H. L. Fuller, deceased. Mr. Knapp was for many years employed by the Chicago, Burlington & Quincy successively as locomotive fireman, engineman, fuel supervisor, road foreman of engines and air brake instructor. He entered the employ of the Westinghouse Air Brake Company in 1925, as mechanical expert at Denver. A few months later he was transferred to the Salt Lake City, Utah, office in the same capacity, which position he held at the time of his appointment as representative at Denver. P. L. Bradford has been appointed representative of the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company with headquarters at Boston, Mass., to fill the place left vacant since the death of F. H. Whitney. Mr. Bradford entered the employ of the Westinghouse Company in 1919 as mechanical expert at Boston, which position he held continuously until his appointment as representative at Boston.

A. F. STUEBING has been appointed railroad mechanical engineer of the commercial office of the United States Steel Corporation, with headquarters at 71 Broadway, New York. Mr. Stuebing was born in Lewistown, Me., May 24, 1889, and re-



A. F. Stuebing

ceived his education at Cornell University and the University of Illinois. He entered railway service in 1911 with the Boston & Albany, following which he was with the Pennsylvania, with the Chicago, Rock Island & Pacific and with the Simmons-Boardman Publishing Company, as associate editor of the Railway Age and managing editor of the *Railway Mechanical Engineer*. From 1923 to 1932 he was chief engineer of the Bradford Draft Gear Company and its successor, the Bradford Corporation, and since has been chief engineer of the Par Car Corporation. He is a member of the American Society of Mechanical Engineers and a past chairman of its Railroad Division. Mr. Stuebing has been a frequent contributor to technical periodicals, and has presented numerous papers before engineering societies and railway organizations.

Obituary

JAMES W. RAWLE, vice-president of The J. G. Brill Company, Philadelphia, Pa., died at his home in Lansdowne, Pa., on October 4, after a long illness. Mr. Rawle was born at Williamsport, Pa., on September 6, 1869, where he received his early education. His first employment was with the Bethlehem Steel Company, with which company he was associated for 17 years, having entered their employ in 1889 as a day laborer and working up through the various departments to the position of assistant to the president. In 1906 he entered the employ of The J. G. Brill Company as assistant general manager. In 1914 he was appointed second vice-president and general manager, and in 1926 he was elected vice-president. In addition to being a director of The J. G. Brill Company and its subsidiary companies, Mr. Rawle was a director of The Brill Corporation, the American Car & Foundry Motors Company and The Electric Railway Equipment Securities Corporation. He was actively associated with the Pennsylvania Manufacturers' Association as a member of its executive committee, and was also a director of the association's affiliated companies. During the years 1930 and 1931 he served as president of that association.

JAMES P. ROE, director of research and engineering of the Reading Iron Company, Philadelphia, Pa., died on September 14. Mr. Roe was born on May 19, 1860, at Consett, Wales. At the age of 17 he entered the service of the Consett Iron Company and had been connected with the iron industry since that time. He came to the United States in 1883.

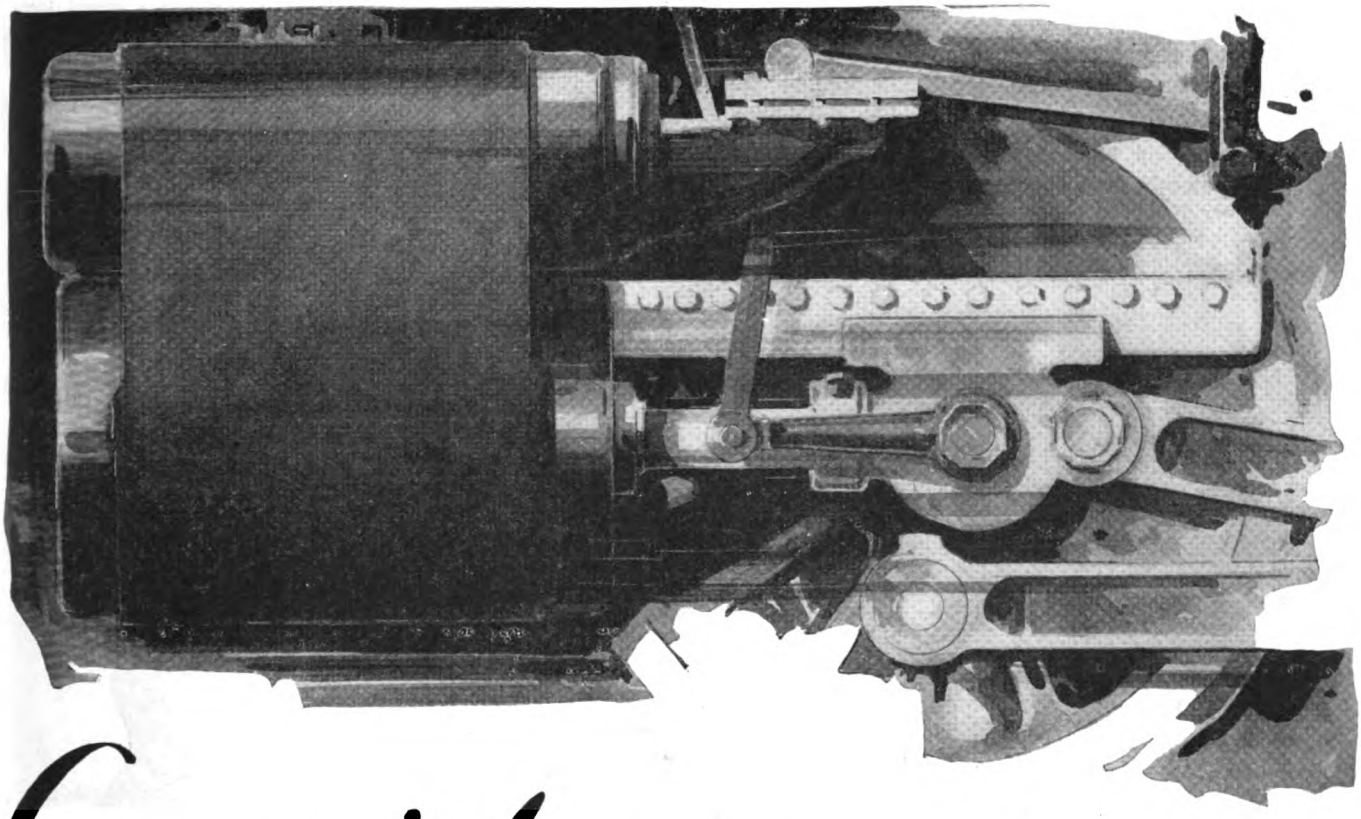
WILLIAM E. MILLHOUSE, president and treasurer of The Burden Iron Company, Troy, N. Y., who died on September 25, at his home in Troy, was born 70 years ago in London, England. Mr. Millhouse came to this country in 1870 and attended the public schools of Troy. In February, 1876, he entered the employ of The Burden Iron Company, and for more than 58 years had been affiliated with the company, having started work at the age of 12 years as



William E. Millhouse

a feeder on one of the swaging machines in its mill, and later working his way up to its presidency. He served in various capacities until 1897, when he was appointed head of the company's wages department. In May, 1907, he was appointed paymaster; two years later he was promoted to assistant secretary and the following year, assistant manager of its mill. On October 22, 1918, Mr. Millhouse was appointed manager of the company, serving in that position until June, 1932, when he was elected executive vice-president and since June of the following year was president of the company. Mr. Millhouse had taken a part in civic affairs, having served as a director of the Troy Chamber of Commerce.

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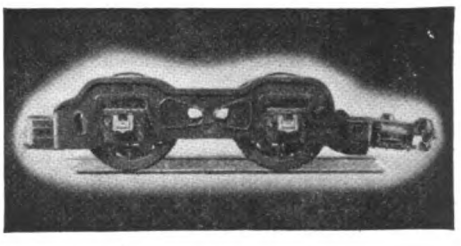
Consider The PISTON THRUST AND ITS EFFECT ON MAINTENANCE COSTS

Obviously the higher the piston thrust the larger the parts must be and the greater the cost for maintenance.

To provide the power needed for starting and for the hard pulls, which may be only 5% of the total time, the main cylinders and related parts must be made larger than are needed for the other 95%—unless the Booster is applied.

Utilization of the Booster permits main cylinders to be proportioned for average conditions over the run; the Booster providing the extra capacity for starting, on grades and for getting in and out of sidings.

Without sacrifice of ton-mile-per-hour capacity, the Booster enables utilization of smaller main cylinders with the resultant lower Piston Thrust and lowered maintenance on both locomotive and track and less capital expenditure.



The close tolerances essential to efficient Booster operation call for genuine repair parts made by Franklin.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

HIRAM G. HAMMETT, president and founder of the Hammett Machine Works at Troy, N. Y., died at his summer home at Grafton on September 22. Mr. Hammett was born in Auburn, Me., 76 years ago. After graduating from the Massachusetts Institute of Technology he entered the service of the Consolidated Safety Valve Company in Boston as a mechanical



H. G. Hammett

engineer, later becoming assistant electrical engineer of the Boston & Albany. For a while he was engaged in the railway supply business in Chicago and, then, a little over 40 years ago, came to Troy, N. Y., and founded the Hammett Machine Works, manufacturing locomotive specialties and machinery. He served at one time as president of the Chamber of Commerce at Troy, and on the Harbor & Dock Commission and the Troy Port Commission. For many years he was a director of the Union National Bank, becoming a vice-president early in 1933. He was active in the affairs of the Society of Engineers of Eastern New York, serving at one time as its president; also a member of the A. S. M. E.

ALBERT G. ELVIN, inventor of railroad equipment appliances, died on October 10 of a heart ailment at his summer home, Munsey Park, Long Island, N. Y., at the age of 69. Mr. Elvin was born at North Vernon, Ind. He began railway work in 1881, serving as boilermaker and machinist apprentice at Peru, Ind., on the Indianapolis, Peru & Chicago, (now part of the New York, Chicago & St. Louis). In 1889 he entered the service of the Pittsburgh, Cincinnati, Chicago & St. Louis (now part of the Pennsylvania) as a machinist at Indianapolis, Ind., and the following year was put in charge of the tool shop, manufacturing all tools for the entire system. He was later general foreman of the Chesapeake & Ohio at Clifton Forge, Va., master mechanic on the Grand Trunk (now part of the Canadian National) at Montreal, Que., and in January, 1901, was appointed general master mechanic of the Delaware, Lackawanna & Western at Scranton, Pa. During this time he designed and put into operation many labor-saving devices. Among these, in 1896, he introduced the first pneumatically-operated turntables and transfer tables in this country. In 1902 he invented and patented the Elvin driving box lubricator, later known as the Franklin driving box lubricator, which became standard on the majority of locomotives in this country and Canada. In 1903 he became associated with the Franklin Railway Supply Company, then known as the Coffin-Megeath Supply Company, and remained with the company as mechanical manager until 1916, when he retired from active work due to illness. During the time he was with the Franklin Railway Supply Company he invented and patented a pneumatic firedoor and the steam grate shaker. He later invented the Elvin mechanical stoker for steam locomotives. In 1920 he formed in New York the Elvin Mechanical Stoker Company, of which he was vice-president in charge of operation and treasurer. In 1925 he sold his interest in the company and retired from business. Mr. Elvin was well known among railway mechanical engineering men and was a member of the American Society of Mechanical Engineers. He also took an interest in civic affairs, having served as mayor of Plandome, Long Island, and later was mayor at Flower Hill.

Personal Mention

Car Department

WILLIAM LEE, car foreman of the Union Pacific at North Platte, Neb., has been appointed general car foreman, with headquarters at Grand Island, Neb.

Shop and Enginehouse

FRANK BRODBECK, enginehouse foreman of the Union Pacific at Council Bluffs, Iowa, has been appointed general locomotive foreman, with headquarters at Kansas City, Kan.

Obituary

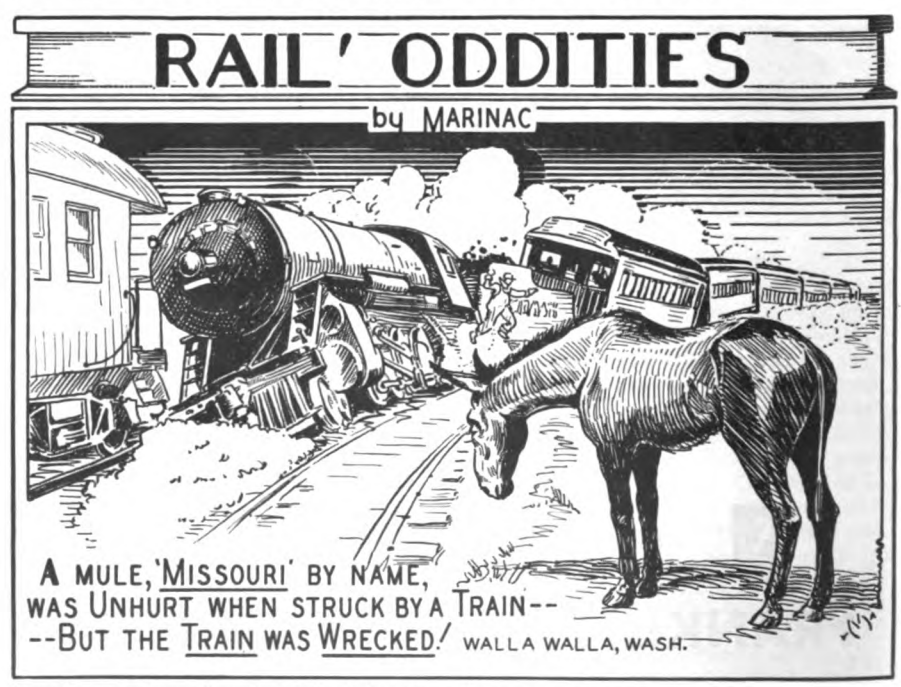
JOSEPH HAINEN, former assistant to the vice-president of the mechanical department of the Southern, died on October 17 at Sibley Hospital, Washington, D. C., of blood poisoning after a short illness. Mr. Hainen, who was 69 years old, retired from active service with the Southern in March, 1923.

H. H. HUMMEL, assistant to the general superintendent of motive power of the Southern Pacific, Pacific Lines, with headquarters at San Francisco, Cal., retired on September 1 because of ill health after 44 years of service with this company. The position of assistant to the general superintendent of motive power has been abolished.



H. H. Hummel

Mr. Hummel entered the service of the company in 1890 and served for many years as chief clerk under three general superintendents of motive power. He had been assistant to the general superintendent of motive power since 1927.



Further explanation furnished by the editor upon request

Railway Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal
With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office

December, 1934

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Published on the 26th day of the month preceding the date of issue by the

Simmons-Boardman Publishing Company

1309 Noble St., Philadelphia, Pa. Editorial and Executive Offices,
30 Church Street, New York, N. Y., and 105 West Adams Street, Chicago, Ill.

Cleveland: Terminal Tower
Washington: 832 National Press Bldg.
San Francisco: 58 Main St.

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Subscriptions, including 12 regular monthly issues, payable in advance and postage free. United States and possessions: 1 year, $3; 2 years, $5. Canada, including duty: 1 year, $3.50; 2 years, $6. Foreign countries: 1 year, $4; 2 years, $7.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service.

NRA U.S. CODE GRAPHIC ARTS INDUSTRY

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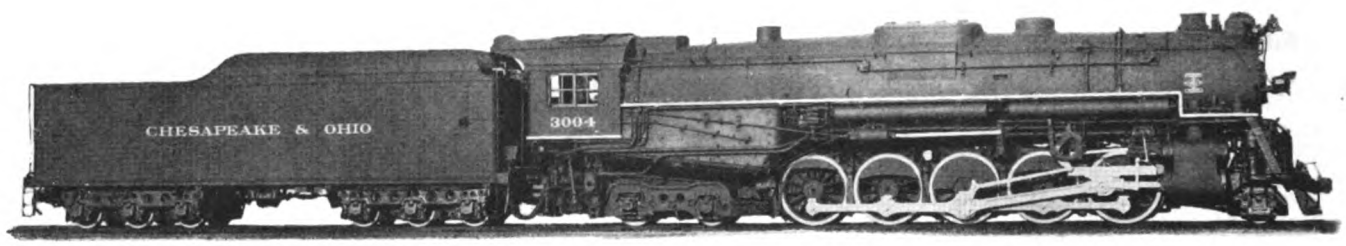
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To Increase Net Earnings



Faster service is the keynote of modern freight movement.

Super-Power Locomotives are available that provide high hauling capacity at passenger train speeds.

Such power is economical to operate and economical to maintain.

It offers the lowest cost per 1,000 ton-miles of any means of transportation.

LIMA LOCOMOTIVE WORKS INCORPORATED

LIMA LOCOMOTIVE WORKS INCORPORATED, LIMA, OHIO

Railway
Mechanical Engineer

Founded in 1832 as the American Rail-Road Journal

December - 1934

Heavy 4-8-4 Locomotives For the Northern Pacific

Passenger power has 77-in. drivers and develops 69,800 lb. tractive force. The firebox, for lignite coal, has 115 sq. ft. of grate area. All driving journals have Timken roller bearings

TEN passenger locomotives of the 4-8-4 type have been delivered to the Northern Pacific by the Baldwin Locomotive Works. These locomotives, which are the second order of this type to be purchased by the road, are among the heaviest and most powerful of the type yet built and the 77-in. driving wheels are one inch larger than the largest previously employed on locomotives of this type. With cylinders 28 in. by 31 in. and a boiler pressure of 260 lb., these locomotives develop a rated tractive force, with 70 per cent maximum cut-off, of 69,800 lb. All the driving-axle journals are fitted with Timken roller bearings.

The locomotives of the first order, particulars of which are included in the table of comparisons with other 4-8-4 type locomotives, develop 57,500 lb. tractive force and have driving wheels 73 in. in diameter.

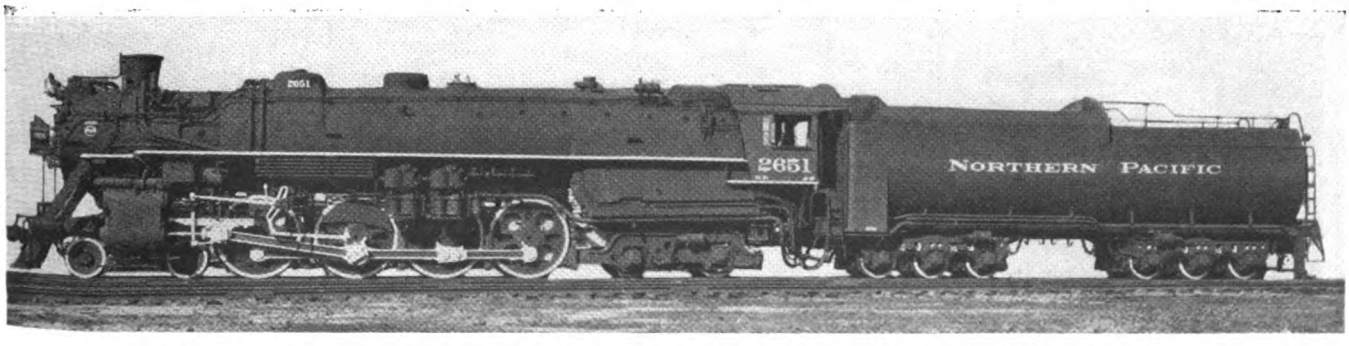
A prominent feature of the proportions of these locomotives is the firebox which has a grate area of 115 sq. ft. As in the case of other locomotives built for the Northern Pacific during the past six years, this is occasioned by the extensive use of Rosebud lignite coal in locomotive service. The heating value of this fuel is about 8,700 B.t.u per pound. It has a moisture content of over 20 per cent and runs under 8 per cent in ash.

The Boiler

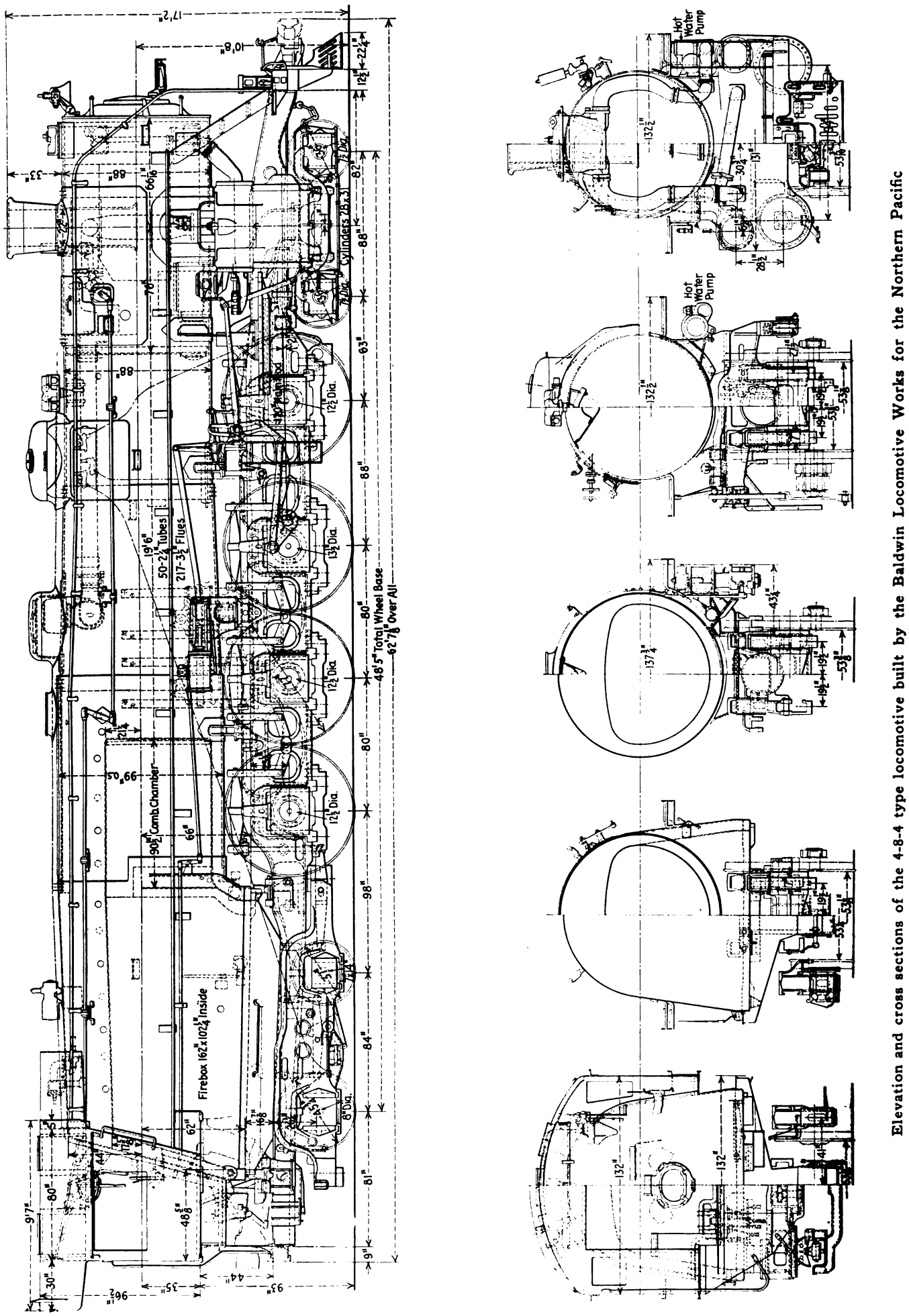
The boiler and firebox are constructed from plates of Lukens basic carbon steel and the boiler barrel has a diameter of 88 in. outside the first ring. The firebox is 162 in. long by 102¼ in. wide, which provides a grate area of 115 sq. ft. and a ratio to heating surface of 1 to 43.16. The combustion chamber is 90 in. long, thus bringing the length of the tubes and flues down to 19 ft. 6 in.

Welding is used extensively to seal the firebox seams. The back tube sheet is welded, both inside and outside, after calking. The firebox door sheet is welded to the crown and sides, which are formed from a single sheet. The outside throat sheet is also sealed with electric welding after calking. Flannery Telltale staybolts, with welded caps, are used for the full length of the combustion chamber, for the first three rows of roof stays back of the seam and in the breaking zone.

The brick arch is supported on five 4-in. tubes. The boilers are fitted with Elesco Type E superheaters. Five of them are equipped with Worthington feedwater heaters and five with Wilson water conditioners. Coal is fed



Northern Pacific 4-8-4 type, Class A-2, heavy passenger locomotive



Elevation and cross sections of the 4-8-4 type locomotive built by the Baldwin Locomotive Works for the Northern Pacific

by a modified Type B du Pont-Simplex stoker with a capacity of 25,000 lb. of coal per hour. The front end is fitted with a Cyclone spark arrester.

Separate turrets are provided for superheated and saturated steam. The superheated-steam turret in the smokebox provides for the blower, air pumps, whistle, headlight turbo-generator and the stoker. The saturated steam turret in the cab provides steam for the injector, the feedwater heater, the power reverse gear, lubricator heaters, drifting valves, steam heat in the cab and train, and the coal pusher. The boiler has no auxiliary dome; the safety valves are screwed directly into the third boiler course back of the main dome. The whistle is mounted alongside the smokebox. The boilers are fitted with Wilson sludge-removers and air-operated blow-off cocks.

Foundation and Running Gear

The locomotive is built on the General Steel Castings Corporation bed, with which are cast the cylinders, including the back heads, the air reservoirs and the inside cradle. A unique feature of the cylinders, shown on the drawings, is the extension of the saddle flange high up on each side of the smoke arch, and the inclusion of the outside steam pipe connection as a part of the saddle. The lower ends of the branch pipes are directly connected to the saddle passages to the steam chests in pockets in the casting which open directly into the smokebox. Thus, the troublesome gland-packed openings through the smokebox are entirely dispensed with.

The 70-in. driving-wheel centers are of the General Steel Castings Corporation Boxpok design, which were cast of Vanadium steel by the Standard Steel Works Company. The advantage of the disk design in a wheel center of such large diameter lies in securing a better casting than with the conventional spoke design. The main wheels of the locomotive are cross-counter-balanced according to the A.R.A. method. One locomotive is fitted with the Prendergast interlocking spring rigging.

All driving axles are fitted with Timken roller bearings. These are provided with safety bombs—chemical cartridges inserted in the bearing housings—which warn against overheating by giving off visible fumes before bearing temperatures have reached a dangerous point. The Alco lateral motion device is applied to the front driving box, giving a lateral of 1 in. on each side between the boxes and pedestals. This reduces the rigid wheel base to 13 ft. 4 in. The other driving boxes are all fitted with ⅜-in. total lateral play.

The connecting rods are of annealed, open-hearth steel with solid ends. The front end of the main rod is fitted with a solid brass bushing pressed in. The back end of the main rod and the side rods are all fitted with fixed bushings of Hunt Spiller gun iron, pressed in, and with floating bushings of brass.

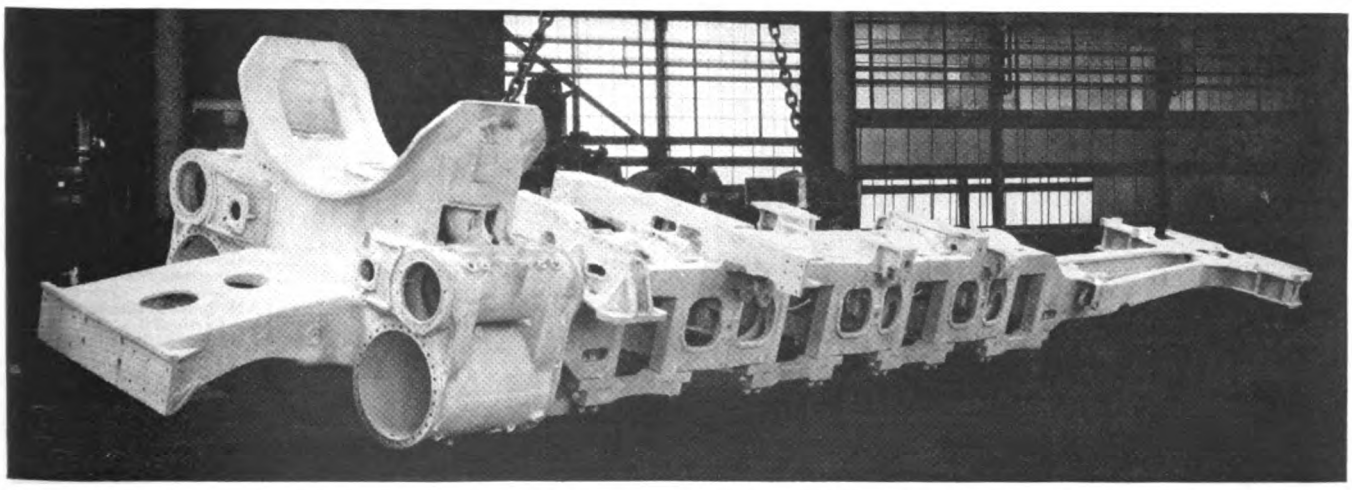
The engine truck is of the four-wheel, center-bearing, General Steel Castings constant-resistance type, with a one-piece cast-steel frame. The wheels are rolled steel, 36 in. in diameter, and are mounted on axles with Timken roller bearings in inside journal boxes. The trailer truck is the four-wheel Delta constant-resistance type with a one-piece cast-steel frame. The front axle is fitted with American Steel Foundries roller-bearing unit with Timken centering device on the box and 37-in. rolled-steel wheels. The rear axle has Timken roller bearings in outside boxes and 45¾-in. steel tired wheels. All axles and crank pins are of open-hearth carbon steel, normalized and tempered. The locomotive axles are hollow bored, as are also the main crank pins.

The 14-in. piston valves are driven by a Walschaert

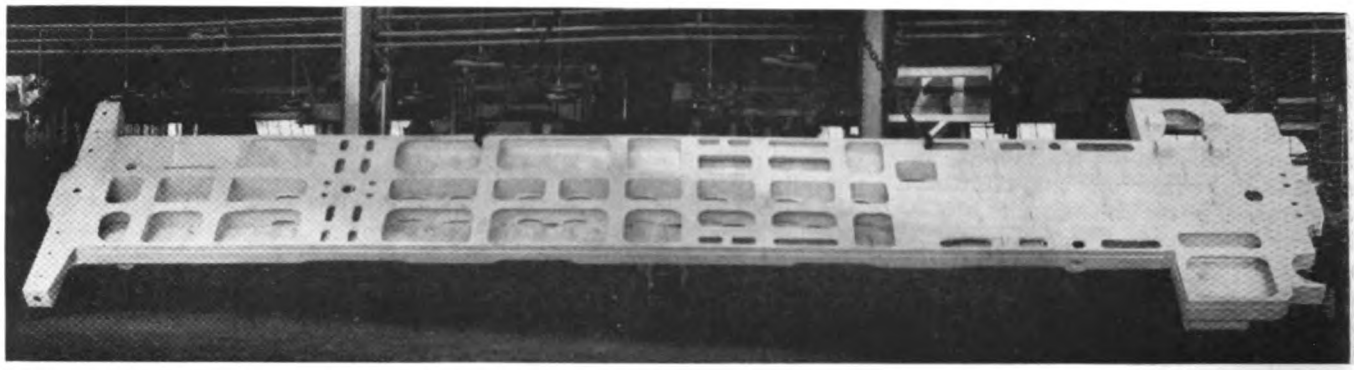
Comparison Table of Some Recent 4-8-4 Type Locomotives

Road	Nor. Pac.	Nor. Pac.	Grt. Nor.	C.B.&Q.	C.&N.W.	C.M.St.P.&P.	C.R.I.&P.	Sou.Pac.	Wabash	St.L.-S.W.
Builder	Bald.	Amer.	Bald.	Bald.	Bald.	Bald.	Amer.	Bald.	Bald.	Bald.
Road Class or No.	A-2	A-1	S-2	0-5	H	S-1	5,027	GS-1	O-1	L-1
Tractive force, lb.	69,800	57,500	58,300	67,500	65,200	60,000	66,000	60,000	70,817	61,500
Weight of engine, lb.	489,400	426,000	420,900	454,590	498,000	450,838	436,000	442,300	454,090	422,500
Weight on drivers, lb.	279,800	260,000	247,300	271,680	288,000	258,814	266,500	262,000	274,100	242,500
Cylinders, in.	28 x 31	28 x 30	29 x 29	28 x 30	27 x 32	28 x 30	26 x 32	27 x 30	27 x 32	26 x 30
Drivers, diam. in.	77	73	80	74	76	74	69	73½	70	70
Steam pressure, lb.	260	210	225	250	250	230	250	250	250	250
Heat. surface, firebox, total, sq. ft.	542.8	485	379	439	558	540	515	356	495	469
Heat. surface, tubes and flues, sq. ft.	4,421.5	4,115	4,402	4,878	4,656	4,860	4,928	4,500	4,689	4,259
Tube length, ft.-in.	19-6	21-0	22-0	21-0	21-0	21-0	21-6	21-6	21-0	20-0
Superheat. surface, sq. ft.	2,174	1,992	2,265	2,403	2,357	2,403	2,243	2,565	2,360	2,060
Grate area, sq. ft.	115	115	97.7	106.5	100	103	88.3	90.4	96.2	88.3
Superheater	E	E	E	E	E	E	E	E	E	E
Feedwater heater	Worth.	Exh. inj.	Exh. inj.	Elesco	Worth.	Worth.	Worth.	Worth.	Worth.	Worth.
Booster	No	Yes	No	No	Yes	No	Yes	Yes	No	No

Note 1:—Northern Pacific Class A-1 was built in 1927; Chicago & North Western in 1929; others in 1930 or later.
Note 2:—Tractive force is for main cylinders only and does not include booster.



Commonwealth locomotive bed for Northern Pacific 4-8-4 type locomotives which includes frames, rear cradle, cylinders with back heads and main reservoirs, and weighs 79,000 lb. complete with pedestals



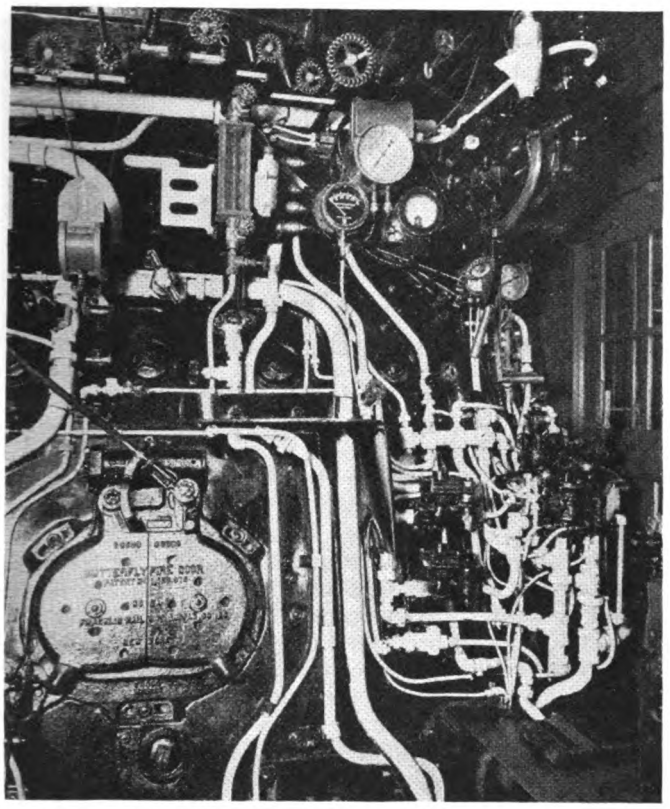
The Commonwealth cast-steel water-bottom tender frame weighs 31,800 lb.

valve gear with a maximum travel of 7½ in. and designed for a limited maximum cut-off of 70 per cent, controlled by an Alco power reverse gear. The locomotive is also equipped with an Alco power-operated throttle lever with provision for auxiliary manual operation, and with the American multiple type throttle. The dry pipe is fitted with the Tangential steam dryer and shut-off valve.

The tender has a General Steel Castings water-bottom underframe with a modified Vanderbilt type tank of welded construction. The water capacity is 20,000 gallons and fuel space is provided for 27 tons. The tender is carried on two General Steel Castings six-wheel trucks. The truck wheels are 37 in. in diameter and the axles are fitted with American Steel Foundries roller-bearing units. The tenders are equipped with track sprinklers.

Special Equipment Applied on Northern Pacific 4-8-4 Type Locomotives

Railroad	Northern Pacific
Builder	Baldwin Locomotive Wks.
Road class	A-2
Road numbers	4650—4659
Boiler:	
Boiler and firebox steel	Lukens
Staybolts	Ulster Special
Flexible staybolts	Flannery
Button-head radials (12 rows center of crown)	Agathon Nickel Iron
Brick arch	American—Security
Smokebox door hinges	Okadee
Spark arrester	Loco. Firebox—Cyclone
Blower nozzles	TZ
Smokebox blower fitting	Barco
Superheater	Elesco Type E
Throttle	American—Multiple
Steam dryer and shut-off valve	Tangential
Lagging	Johns-Manville
Feedwater heater (5)	Worthington
Water conditioner (5)	Wilson
Inspirator (1,000 gal.)	Hancock—K.N.L.
Boiler checks	Hancock
Blow-off cocks (air operated)	Wilson—N.C.
Sludge remover	Wilson
Washout plugs	TZ
Stoker	Standard—Modified du Pont-Simplex
Firedoor	Franklin—Butterfly No. 8
Grates (1 engine)	Firebar
Cabs, fittings, boiler mountings:	
Safety valves	Consolidated
Pressure gages	Ashton—Double dial
Back-pressure gage	Ashton—Duplex (with pulsation retarding device)
Speed indicator	Weston Electric
Water column	Edna
Drainpipe receptacles through cab floor	TZ
Low-water alarm	Barco
Valves, globe	Crane
Valves, globe on stoker	Hancock
Car heating equipment	Vapor Car Htg.
Whistle	Hancock chime
Whistle operator	Viloco
Bell ringer	U. S. Metallic Pack.—King No. 33
Sander	Graham-White
Track sprinkler valve (tender)	Walworth
Headlight generator (5)	Pyle-National
Headlight generator (5)	Sunbeam
Marker lamps	Adams & Weatlake—Cast aluminum
Back-up lamps	Pyle-National
Power throttle lever	Alco
Clear-vision windows	Prime
Cab seats	Gustin-Bacon (with McEntire spring seat cushion)
Running boards	Irving Iron Wks.—Safkar
Running-board steps	Visabledge Safstep
Cylinders and driving gear:	
Limited cut-off	Franklin
Bushings	Hunt-Spiller Gun Iron
Piston-packing rings	Hunt-Spiller—Duplex
Piston-rod and valve-stem packing (5)	U. S. Metallic Pac.—King type
Piston-rod and valve-stem packing (5)	Crescent—King type
Rod brasses	National Bearing Metals.—Arctic
Crosshead and wrist pin	Union Steel Casting.—Hubbard
Connecting-rod bushings	Hunt-Spiller Gun Iron
Power reverse gear	Alco Type G
Drifting valve	Crane, Chronometer type
Cylinder cocks	Okadee Automatic
Frames and running gear:	
Locomotive bed	General Steel Castings
Pilot beam	General Steel Castings
Driving-wheel centers	Boxpok
Driving-axle bearings	Timken
Lateral motion device	Alco
Springs	American Steel Foundries
Interlocking spring rigging (1)	Prendergast
Truck, engine, 4-wheel	General Steel Castings—Center bearing, constant resistance
Truck, trailer, 4-wheel Delta	General Steel Castings
Wheels, engine truck	Standard Steel Wks.—Rolled steel
Wheels, front axle trailer truck	Standard Steel Wks.—Rolled Steel
Wheels, rear axle trailer truck, steel tired, Hy-lastic Vanadium steel center	Standard Steel Wks.
Centering device, front trailer axle boxes	Timken
Engine-truck bearings	Timken (inside)
Trailer truck, front axle bearing	American Steel Foundries, Roller
Trailer truck, rear axle bearing	Timken (outside)
Pilot	General Steel Castings
Radial buffer	Type D
Couplers	National Malleable & Steel Castings
Coupler release rigging	Imperial
Draft gear	Miner A-94-X-B
Lock nuts	Grip Nut
Lubrication:	
Mechanical lubricator	Nathan—DV3
Hydrostatic lubricator (Air pump, stoker and feedwater pump)	Detroit 4-feed (one feed blanked)
Piston and rod grease lubricator	Viloco
Pin and valve motion	Alemite
Guide oil cups	Hancock
Flange lubricator	Imperial
Brakes:	
On drivers, engine truck and trailer	American
Operating brake	6ET
Air compressors	2—8½-in. cross-compound
Tender:	
Frame, water bottom	General Steel Castings
Trucks, 6-wheel	General Steel Castings
Truck axle bearings (37-in. wheels)	American Steel Foundries—Roller
Journal boxes (6½ in. by 12 in.)	National Malleable & Steel Castings
Dust guards	Butler Railway Supply—Pro-tec-to
Truck side bearings	Stucki
Truck brakes	American Steel Foundries—Simplex Clasp
Coal pusher	Standard Stoker—Type DA
Flexible connections, engine and tender	Barco
Tank hose coupler	TZ
Tank valves	TZ
Coupler	National Malleable & Steel Castings
Paint (tender)	Duco



Right side of back boiler head

The locomotives are equipped with the No. 6 ET brake applied to all driving, truck and tender wheels. Two 8½-in. cross-compound compressors are mounted on the left side of the boiler. Five of the locomotives have Pyle-National, and five Sunbeam turbo generators. Other accessories include the Franklin Butterfly fire door, Barco low-water alarm and a Hancock non-lifting inspirator of 10,000 gallons capacity.

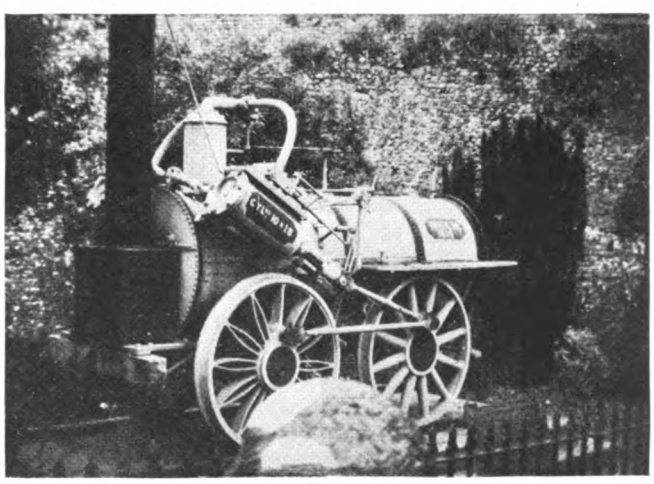
These locomotives were designed for use in heavy through passenger service and for handling silk specials in continuous runs between Jamestown, N. D., and Missoula, Mont. The 904 miles of line between these points includes sections of rolling grade, water level grades, and heavy mountain grades. They will replace the 12 lighter 4-8-4 type locomotives of the first order, which have been assigned to other districts. The first of the locomotives, which was turned out of the Eddystone plant of the Baldwin Locomotive Works in September, was on exhibition at the Wings of a Century Pageant at the Century of Progress Exposition at Chicago from September 15 to October 5 before proceeding to its home rails.

The principal data and dimensions are given in one of the tables.

Table of Dimensions, Weights and Proportions of the Northern Pacific 4-8-4 Type Locomotives

Railroad	Northern Pacific
Builder	Baldwin Locomotive Works
Road class	A-2
Type of locomotive	4-8-4
Service	Passenger
Cylinders, diameter and stroke	28 in. by 31 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	7½ in.
Crank throw	19½ in.
Steam lap	1 15/16 in.
Exhaust clearance	3/4 in.
Lead, constant	¼ in.
Cut-off in full gear, per cent	70
Weights in working order:	
Total engine	489,400 lb.
On drivers	279,800 lb.
On front truck	96,600 lb.
On trailing truck	113,000 lb.
Tender	387,600 lb.
Wheel bases:	
Driving	20 ft. 8 in.
Rigid	13 ft. 4 in.
Engine total	48 ft. 5 in.
Engine and tender, total	95 ft. 3 in.
Wheels, diameter outside tires:	
Driving	77 in.
Front truck	36 in.
Trailing truck	37 in. and 45¾ in.
Journals, diameter and length:	
Driving, main	13½ in.
Driving, others	12½ in.
Front truck	7½ in.
Trailing truck	7 in. and 8 in.
Boiler:	
Type	Conical
Steam pressure	260 lb.
Fuel, kind	Rosebud coal
Diameter, first ring, outside	88 in.
Firebox, length and width	162 in. by 102¼ in.
Height mud ring to crown sheet, back	79⅝ in.
Height mud ring to crown sheet, front	87¼ in.
Arch tubes, number and diameter	5—4 in.
Combustion chamber length	90½ in.
Tubes, number and diameter	50—2¼ in.
Flues, number and diameter	217—3½ in.
Length over tube sheets	19 ft. 6 in.
Grate area	115 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	480.2 sq. ft.
Arch tubes	62.6 sq. ft.
Firebox, total	542.8 sq. ft.
Tubes and flues	4,421.5 sq. ft.
Total evaporative	4,964.3 sq. ft.
Superheating	2,174.0 sq. ft.
Comb. evap. and superheat	7,138.3 sq. ft.
Special Equipment:	
Brick arch	Yes
Superheat	Elesco Type E
Feedwater heater (5)	Worthington 6-S-A
Feedwater conditioner (5)	Wilson
Stoker	Duplex-Simplex Type B modified
Tender:	
Style	Vanderbilt W.B.
Water capacity	20,000 gal.
Fuel capacity	27 tons
General Data, estimated:	
Rated tractive force (70 per cent cut-off)	69,800 lb.
Potential horsepower (Cook)	4,000 hp.
Speed at 1,000 ft. piston speed	44.45 m.p.h.
Piston speed at 10 m.p.h.	225.6 ft.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	57.2
Weight on drivers ÷ tractive force	4.0
Weight engine ÷ potential hp.	122.3
Weight engine ÷ comb. heat. surface	68.6
Boiler proportions:	
Tractive force ÷ comb. heat. surface	9.8
Tractive force x dia. drivers ÷ comb. heat. surface	753.0
Comb. heat. surface ÷ grate area	62.1
Comb. heat. surface ÷ potential hp.	1.78
Potential hp. ÷ grate area	34.8
Firebox heat. surface ÷ grate area	4.72
Firebox heat. surface, per cent of evap. heat. surface	10.95
Superheat. surface, per cent of comb. heat. surface	30.5

* * *



"Invicta"—Built by Stephenson in 1880 for the Canterbury & Whitstable, the second English railway for public use to employ a steam locomotive. Wheels, 4 ft. diameter; cylinders 10½ in. by 18 in. Now preserved at Canterbury (a few slight changes have evidently been made since originally built.)

Determining Car-Wheel Eccentricity

By W. E. Gray*

Part I—Lack of rotundity and concentricity of car wheels seriously affects riding qualities—New gages developed for accurate testing

THE evil effects of eccentric and out-of round wheels under passenger and freight cars are becoming more and more clearly recognized every day. Patrons of transportation are rapidly becoming more critical of bad riding qualities in railway passenger cars, some of which may be chargeable to the condition of the wheels. Availability of trucks for freight hauls makes it no longer possible to hold business in the face of dissatisfaction with shipments delivered in damaged condition, even though damage claims are paid, and this same truck competition is also forcing higher and higher freight train speeds which is making more and more pressing the question of riding qualities of freight cars. No detail, however seemingly small, can afford to be overlooked in the battle to retain the railroads as the nation's basic purveyor of transportation. Railway cars in motion are subjected to periodic vertical displacements by wheels the treads of which are not true with the journals of the axles. At certain speeds the frequency of these disturbances synchronizes with the natural period of the springs on the car and oscillations are caused which may be violent enough to be very uncomfortable to passengers or to damage fragile lading. The remedy lies in eliminating the cause of this disturbance by having the wheels as true as possible. There are other factors which also produce synchronous oscillations but they are not considered in this article.

Wheels have been under close scrutiny for a number of years as regards roundness and concentricity, but the subject reminds one of Mark Twain's comment about the weather, "There is more said and less done about it than any other thing of which he knew." Perhaps one reason that so little progress has been made in the matter of improving the condition of wheels is because so many difficulties have been encountered in measuring mounted wheels to tell just how true they are. These difficulties apply to new wheels as well as to wheels that are installed under cars. In the large majority of cases the roundness of new wheels is essentially a question of manufacture; concentricity is a question of wheel shop practice, and unless close work is done in both factory and wheel shop mounted wheels will not be as true as it is possible to make them. The manufacturer is equipped with ring gages which have proven satisfactory for determining the roundness of wheels but the wheel shop has not had any such satisfactory device for checking its part of the work of preparation of the wheels for service, and the repair yards have been woefully lacking in equipment for determining the condition of worn wheels.

Offhand it might seem to be a fairly simple task to tell quickly how round and concentrically mounted a pair of wheels are, but a little reflection will show that it is not such a simple job as it seems. If it is a question of a pair of wheels that are under a car the problem is much more complicated. For this situation the A.A.R. has recently recommended a gage that is made in the form of a circular arc 12 in. long. This gage is applied to the tread of the wheel and if there is not more than 1/16 in. space between the gage and the tread at any point in the 12 in. the wheel is presumed to be satisfactory. It is almost obvious that the information gained by using such a gage is useless, because in the attempt to provide a usable gage the correct principle of measurement was submerged. Eccentric mounting can be productive of bad riding qualities just as well as wheels being out of round, and this gage cannot give any information on that point. The limit of 1/16 in. in 12 in. is also rather questionable, as this seems to be large enough to cause serious disturbance to car riding.

Table I is presented to show the actual condition of four pairs of used cast iron wheels which had been passed as serviceable by this gage and were later measured by another method. The measurements given are the differences in radial distance between journal surface

* Engineering Experiment Station, Purdue University, Lafayette, Ind.

Table I—Eccentricity Measurements of four Pairs of Cast-Iron Wheels not Condemnable with the A. A. R. 12-in. Arc Gage*

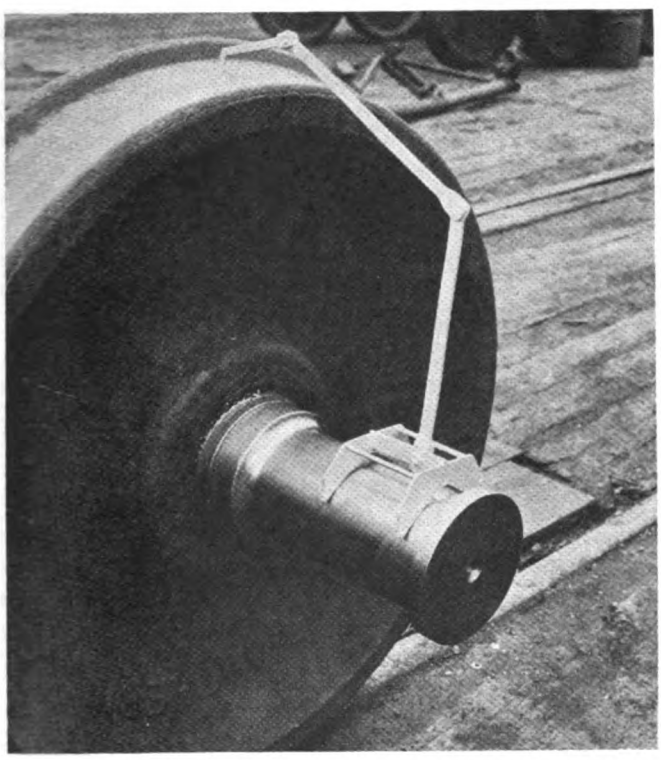
Mark No.	Pair No. 1		Pair No. 2		Pair No. 3		Pair No. 4	
	Left	Right	Left	Right	Left	Right	Left	Right
1	.115	.000	.000	.010	.000	.070	.000 1.3–.010 1.8–.000	.012
2	.061	.040	.052	.000	.110 2.6–.155	.065 2.5–.072	.018	.078
3	.035	.077	.113	.003	.128 3.2–.123	.038 3.6–.000	.077	.156
4	.015	.092	.132	.043	.182 4.2–.192	.014 4.2–.003	.155	.192
5	.000	.113	.129	.091 5.4–.105	.168 5.5–.193	.035 5.9–.071	.181 5.1–.189	.150
6	.064	.122	.084	.098	.180 6.4–.134	.065 6.3–.060	.168	.087
7	.118	.095	.016 7.8–.032	.077	.145 7.8–.087	.082 7.5–.071	.110	.009 7.1–.002 7.8–.017
8	.130	.046	.020	.041	.098 8.2–.101	.087 8.6–.061	.035	.000 8.5–.023

* All measurements are in inches above the minimum radial distance from journal surface to wheel tread.

and wheel tread at the reference marks as noted, the minimum radial distance being called zero. Eight of these reference marks are equally spaced around the circumference of the wheel. They are numbered from 1 to 8 and corresponding marks on the two wheels of a pair are in line. Where the tread changes direction of its trend between two adjacent marks the position of maximum or minimum reading is given by a decimal fraction.

The information presented in Table I is sufficient to show that useful data cannot be obtained with this type of gage. These wheels were later installed under a freight car and a riding qualities test made which showed violent bouncing at speeds between 25 and 30 m.p.h. which was not present when the car was equipped with true wheels.

When the wheels are not under a car the problem of measuring their condition is not quite so difficult, but it is still far from being a simple task in order to secure the necessary accuracy. One of the illustrations shows a gage for this purpose which is based on the correct principle, since it is designed to check the radial distance from the journal to the wheel tread. In order that the car be not subjected to vertical movements by the wheels as they revolve it is necessary that this radial measurement does not vary at different points around the circumference. The proper measurement is from the journal through the center of the axle to the point on the wheel tread diametrically opposite, as these two points are the ones in engagement between the car and the track at any one time, but if the journals are round, as they should be, there will be no error introduced by measuring from the journal to the tread on the same side of the journal. The main difficulty with this gage is that in the interests of making it light and portable it has suffered in dependability and accuracy. The base for contact on the journal is too small for any great reliability and the accuracy of measurement that can be secured is not very great. With wheels that are absolutely round this gage might be used to check eccentricity within 1/32 in. but if the wheels are not truly round then it is a rather hopeless task to obtain an accurate record of their condition with this gage.



Wheel concentricity gage—This type of gage not satisfactory for accurate work

The one reliable method of checking wheel conditions that has been in use is to swing them on the axle centers in a lathe. While this method gives reliable results there are certain other considerations which make it more or less impractical. The wheels have to be removed from the car and transported to the wheel shop. A great many wheel shops are not equipped with lathes large enough to swing a pair of mounted wheels, this being particularly true of shops where cast iron wheels alone are handled. Standard equipment in such shops includes only an axle lathe. Since there are so many more cast iron wheels used than all other kinds put together it will be appreciated that many wheel shops cannot check mounted wheels in lathes even if they wanted to go to the trouble of taking them from under the cars and sending them to the shop.

From the foregoing discussion it will be apparent that it is not entirely a lack of interest in the problem that is responsible for there not having been more progress made in the matter of properly mounting new wheels and removing from service wheels that have worn so badly out of true that they should be replaced. A great many cast iron wheel shops may be putting out wheels that are not as perfectly mounted as they might be, but this is because they have no way of checking the wheels to know what results are attained.

In Table II are shown tread eccentricity conditions for four pairs of new cast iron wheels as they came from a wheel shop, these being representative of the output of this shop at the time the check was made. The foreman of this shop had no idea that the wheels he was turning out were not as perfect as they might be because he had no way of accurately measuring his work. When this condition was discovered he immediately made an improvement in the quality of his output by carefully checking up his boring mill and making slight adjustments. It should be evident that there is plenty of room for improvement in gages and methods of measuring wheels for trueness, and it is the purpose of this article to describe some devices recently developed for that purpose with the idea of securing their more general use.

The question arises as to what accuracy is possible in the matter of wheel trueness, and the answer is that it depends to a large extent on the kind of wheels and the methods of preparation used. There are two factors involved in wheel trueness—rotundity and concentricity. A wheel may be round in every sense of the limitations implied by that word and still not be true with the journal because it was bored eccentrically and not trued up after being mounted. If a wheel is not round it cannot be true with the journal because it has no center which is equidistant from every point around the tread. For a pair of wheels to be perfect it is necessary that they not only be absolutely round but that they be mounted on axles having round journals in such a way that the centers of the wheels and of the journals coincide. Obviously these conditions cannot be attained by hit and miss methods, and it is almost as obvious that it is hardly justifiable from an economic standpoint to strive for absolute perfection for every pair of wheels mounted. It is necessary to adopt the happy medium which will bring the largest return on the money invested, and this happy medium depends upon the kind of wheels used, as methods of preparation differ with different kinds of wheels.

Three kinds of wheels are in use on the railroads of this country, cast iron, cast steel and wrought steel. More than ninety per cent of the wheels used are cast iron. These have a hard chilled tread which cannot be machined by any method except grinding, and they are expected to be used without having the tread trued up after mounting. However, a few roads grind the treads of these wheels when they are first mounted in order to true them up with the journals, and a larger number of roads grind flat spots out of used cast iron wheels in order to restore them to a serviceable condition. The amount of material which can be removed from the tread of a cast iron wheel and still leave it useful is limited because the chilled portion of the tread is only about ¾ in. deep when the wheel is new and there must be an appreciable amount of this material left or the wheel will not stand up in service. By far the greater part of cast iron wheels are mounted and used with the treads in the unmachined condition. Cast steel wheels are furnished by the manufacturer with a hardened tread that can only be machined by grinding, but in the process of manufacture the treads of these wheels are turned true before they are hardened. Ordinarily they will be round within very small limits, since the amount of warping that occurs during the heat treating operation after the treads are machined is very small. Wrought steel wheels have a tread which can be machined in a lathe, this tread being formed by rolling during the process of manufacture. A. A. R. specifications require that cast iron wheels from the manufacturer be sufficiently round so that when a truly round ring is used as a gage there shall not be more than 1/32 in. space between the gage and the tread at any point on the circumference of the wheel. For wrought steel wheels this limit is 1/16 in., but they are nearly always trued up in a lathe after they are mounted on the axles. There is no A. A. R. limit for rotundity on cast steel wheels, probably because of the manufacturing method producing wheels that are almost perfectly round.

From the preceding paragraph it will be seen that most of the problem of wheels not being round and true concerns cast iron wheels, both on account of the preponderance of their use and the limitations imposed upon them by manufacture. Since in the majority of cases the treads of these wheels are not machined, any out-of-roundness existing in the new wheel will show up in the mounted wheel. If the wheel is not bored concentric with the true circle which circumscribes its tread, eccentricity will be added to the out of-roundness and the resulting wheel when mounted will show great variation in the radial distance between tread and journal at different points around the circumference. It is necessary to permit some tolerance in locating the bore, say 1/32 in., and when this is added to the 1/32 in. out of round permitted for these wheels we have 1/16 in. as the maximum variation in radial distance between journal and tread for mounted cast iron wheels that are not ground. In Table III are given the measurements for a representative lot of new cast iron wheels coming from the shop that had previously turned out the wheels listed in Table II. These latter wheels are representative of the work turned out after the boring mill had been adjusted as previously mentioned, and show that it is entirely possible to hold within a limit of 1/16 in. for eccentricity on new cast iron wheels. [The details of the new type of wheel concentricity gage referred to, as well as a second gage for use in checking car wheels without the necessity of removing them from under the cars will be illustrated and described in a subsequent issue. —Editor.]

Table II—Eccentricity Measurements of four Pairs of New Cast-Iron Wheels—Boring Mill out of Adjustment*

Mark No.	Pair No. 1		Pair No. 2		Pair No. 3		Pair No. 4	
	Left	Right	Left	Right	Left	Right	Left	Right
1	.061 1.2–.079	.069	.037	.013 1.7–.000	.048	.007 1.6–.000	.000	.040 1.2–.052
2	.072	.031	.000	.013	.000	.016 2.9–.071	.007	.000
3	.077	.011	.018 3.6–.057	.030 3.6–.061	.009	.067	.040	.011
4	.073	.004 4.4–.000	.043	.054 4.7–.043	.052	.051	.038	.050
5	.073	.006	.025	.054 5.7–.071	.052	.043	.032	.068
.6	.053	.017 6.5–.029	.029	.060	.064 6.6–.102	.058	.027	.089
7	.000	.020	.041 7.7–.022	.083	.098	.029	.029 7.9–.050	.098
8	.004	.057	.030 8.6–.058	.053	.072	.025	.039	.070

* All measurements are in inches above the minimum radial distance from journal surface to wheel tread.

Table III—Relatively Small Eccentricity of four Pairs of New Cast-Iron Wheels—Boring Mill Properly Adjusted*

Mark No.	Pair No. 1		Pair No. 2		Pair No. 3		Pair No. 4	
	Left	Right	Left	Right	Left	Right	Left	Right
1	.025	.023	.037 1.8–.043	.012	.014	.017	.056	.000
2	.016	.027 2.3–.040	.036	.036 2.2–.044	.012	.015 2.3–.007	.038	.016 2.8–.042
3	.000	.031	.018	.026 3.8–.000	.008	.021	.026 3.4–.016	.037
4	.023 4.6–.025	.021	.007	.005	.002	.011	.048	.037
5	.007	.014	.000	.023	.013	.012	.021 5.8–.000	.037 5.3–.057
6	.022	.027	.009	.044	.012 6.5–.000	.005	.011	.037
7	.009	.028	.032	.008	.009	.020 7.7–.000	.031	.015
8	.027	.006 8.3–.000	.033	.014	.010	.009	.032	.030

* All measurements are in inches above the minimum radial distance from journal surface to wheel tread.

Air-Conditioned Passenger Cars Placed in Service Since January 1, 1934

Railroad	No. of cars	Type of car	Date equipped	Type of system	Refrigerant	Manufacturer of system	Compressor drive	Generators				Storage batteries		Outside power supply	
								No.	Capacity, kw.	Type of drive	Type of mounting	Make	Amp.-hr. capacity[1]	a. c. or d. c.	Volts
Alton	4	Coaches	6-1934	Mech.	Freon	B. & O.—York	Motor	2	1—4 1—7½	Flat belt Flat belt-gear	Body Body				
	2	Obs.-lounge	6-1934	Mech.	Freon	B. & O.—York	Motor	2	1—4 1—7½	Flat belt Flat belt-gear	Body Body	Exide	1,000	d. c.	32
	2	Comb.	6-1934	Mech.	Freon	B. & O.—York	Motor	2	1—4 1—7½	Flat belt Flat belt-gear	Body Body	Exide	1,000	d. c.	32
A. C. L.	7	Diners	7-1934	St. eject.	Water	Safety C. H. & L.	.....	1	7½	Flat belt	Body	Edison	600	....	....
A. T. & S. F.	4	Cafe-obs.	1934	St. eject.	Water	Safety C. H. & L.	.....	1	7½	Flat belt	Truck	Exide	850	....	....
	8	Club	1934	St. eject.	Water	Safety C. H. & L.	.....	1	7½	Flat belt	Truck	Exide	850	....	....
	14	Diners	1934	St. eject.	Water	Safety C. H. & L.	.....	2	2—4 or 1—2.4 and 1—4	Flat belt	Truck	Exide	640—864	....	....
	10	Lounge	1934	St. eject.	Water	Safety C. H. & L.	.....	1	7½	Flat belt	Truck	Exide	850	....	....
B. & M.	2	Comb.	6-1934	Ice	Ice	B. F. Sturtevant Co.	.....	1	4	Flat belt	Body	Edison	298	....	....
	4	Coach	7-1934	Ice	Ice	B. F. Sturtevant Co.	.....	1	4	Flat belt	Body	Edison	298	....	....
	4	Diners	6-1934	Ice	Ice	Airtrol-Rails Co.	.....	1	5	Flat belt	Body	Edison	426	....	....
B. & O.	5	Diners	1934	Mech.	Freon	B. & O.—York	Motor	2	1—4 1—7½	Flat belt Flat belt-gear	Body Body				
	15	Comb.	1934	Mech.	Freon	B. & O.—York	Motor	2	1—4 1—7½	Flat belt Flat belt-gear	Body Body				
	2	Cafe-club	1934	Mech.	Freon	B. & O.—York	Motor	2	1—4 1—7½	Flat belt Flat belt-gear	Body Body	Exide, USL and K.W.	576, 864 and 1,000	....	....
	1	Lounge	1934	Mech.	Freon	B. & O.—York	Motor	2	1—4 1—7½	Flat belt Flat belt-gear	Body Body				
	6	Reclin. chair	1934	Mech.	Freon	B. & O.—York	Motor	2	1—7½ 1—4	Flat belt-gear Flat belt	Body Body				
	30	Coaches	1934	Mech.	Freon	B. & O.—York	Motor	2	1—4 1—7½	Flat belt Flat belt-gear	Body Body				
C. & O.	4	Salon-coach	4-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	Exide	350	a. c.	220
	1	Business	5-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	2	1—4 1—4	Flat belt V-belt-gear	Body Body	Edison	1,024	a. c.	220
	1	Business	2-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	2	1—4 1—4	Flat belt V-belt-gear	Body Body	Edison	1,024	a. c.	220
C. B. & Q.	2	Coach-lounge[2]	4-1934	Mech.	Freon	G. E.—York	Motor	1	25	V-belt from Diesel engine	....	Exide	450 at 64 V.	a. c.	220
	5	Diners	6-1934	Ice	Ice	C. B. & Q.—Frigidaire	.....	1	4	Flat belt	Body	Exide Gould	500 600	....	....
	3	Diners	6-1934	Ice	Ice	C. B. & Q.—Trane	.....	1	4	Flat belt	Body	Gould	600	....	....
	1	Diner	5-1934	Mech.	Freon	Frigidaire	Motor	2	15	V-belt	Trucks	Edison	1,024	a. c.	220
	1	Lounge	5-1934	Mech.	Freon	Frigidaire	Motor	2	1—5 1—15	Gear V-belt	Body Truck	Edison	2,048	a. c.	220
	1	Lounge	5-1934	Mech.	Freon	Frigidaire	Motor	2	1—4 1—15	V-belt V-belt	Truck Truck	Edison	2,048	a. c.	220
	2	Lounge	5-1934	Ice	Ice	C. B. & Q.—Frigidaire	.....	1	4	V-belt	Truck	Edison	1,024	a. c.	220
	1	Lounge	6-1934	Ice	Ice	C. B. & Q.—Frigidaire	.....	1	4	V-belt	Truck	Edison	1,024	....	....
	2	Lounge-diners	6-1934	Ice	Ice	C. B. & Q.—Trane	.....	1	4	Flat belt	Body	Gould	500	....	....
	3	Lounge-diners	9-1934	Mech.	Freon	Frigidaire	Motor	1	15	V-belt	Truck	Gould	1,000	a. c.	220
	2	Cafe-chair	5-1934	Ice	Ice	C. B. & Q.—Trane	.....	1	4	Flat belt	Body	Edison	426	....	....
	2	Chair	6-1934	Ice	Ice	C. B. & Q.—Trane	.....	1	5	V-belt	Truck	Gould	850	....	....
C. & E. I.	2	Coach	6-1934	Ice	Ice	Safety C. H. & L.	.....	1	4	Flat belt	Body	Gould	600	d. c.	32
	2	Comb.	5-1934	St. eject.	Water	Safety C. H. & L.	.....	1	10	Flat belt	Body	Exide	1,000	d. c.	32
C. M. St. P. & P.	2	Diners	6-1934	St. eject.	Water	Safety C. H. & L.	.....	2	1—5 1—10	Flat belt V-belt	Body Truck	Exide	850	d. c.	32
	2	Club	6-1934	St. eject.	Water	Safety C. H. & L.	.....	2	5	Flat belt	Body	Exide	850	d. c.	32
	7	Cafe-obs.	6-1934	St. eject.	Water	Safety C. H. & L.	.....	1	10	V-belt-gear	Body	Exide	850	d. c.	32
	11	Diners	6-1934	St. eject.	Water	Safety C. H. & L.	.....	1	10	V-belt-gear	Body	Exide	850	d. c.	32

Air-Conditioned Passenger Cars Placed in Service Since January 1, 1934 (Continued)

Railroad	No. of cars	Type of car	Date equipped	Type of system	Refrigerant	Manufacturer of system	Compressor drive	Generators: No.	Generators: Capacity, kw.	Generators: Type of drive	Generators: Type of mounting	Storage batteries: Make	Storage batteries: Amp.-hr. capacity[1]	Outside power supply: a. c. or d. c.	Outside power supply: Volts
C. & N. W.	4	Diners	1934	Ice	Ice	Trane	.....	1	4	Flat belt	Body	Exide	400	....	....
	1	Lounge	6-1934	Mech.	Methyl-chloride	Melcher	Motor	1	4	Spicer gear	Body	Exide	400	....	....
								1	7½	V-belt-gear	Body	Exide	800	....	....
	2	Cafe-lounge	6-1934	Ice	Ice	Safety C. H. & L.	.....	1	4	Flat belt	Body	Exide	400	....	....
	3	Lounge	6-1934	Ice	Ice	Young Rad. Co.	.....	1	4	Flat belt	Body	Exide	400	....	....
	1	Lounge	6-1934	Ice	Ice	Trane	.....	1	4	Flat belt	Body	Exide	400	....	....
	6	Diners	6-1934	Ice	Ice	Trane	.....	1	4	Flat belt	Body	Exide	400	....	....
C. R. I. & P.	4	Bagg.-club	6-1934	Ice	Ice	A. C. & F.	.....	1	4	Flat belt	Body	USL	450	d. c.	32
	3	Cafe-lounge	6-1934	St. eject.	Water	Safety C. H. & L.	.....	2	4	Flat belt	Body	Exide	850	d. c.	32
												Gould	850	d. c.	32
												USL	850	d. c.	32
	4	Obs.-lounge	6-1934	St. eject.	Water	Safety C. H. & L.	.....	2	4	Flat belt	Body	2 Exide	850	d. c.	32
												1 USL	850	d. c.	32
												1 Gould	850	d. c.	32
	5	Diners	6-1934	St. eject.	Water	Safety C. H. & L.	.....	2	4	Flat belt	Body	2 Gould	850	d. c.	32
												1 Exide	850	d. c.	32
												2 USL	850	d. c.	32
	1	Cafe-lounge	6-1934	Ice	Ice	A. C. & F.	.....	1	4	Flat belt	Body	USL	450	d. c.	32
D. L. & W.	2	Diners	6-1934	Ice	Ice	Safety C. H. & L.	.....	1	5	Flat belt	Body	Lead	600	....	....
	4	Diners	6-1934	Ice	Ice	Safety C. H. & L.	.....	1	4	Flat belt	Body	Lead	600	....	....
	2	Buffet	6-1934	Ice	Ice	Safety C. H. & L.	.....	1	5	Flat belt	Body	Lead	600	....	....
	1	MU-club	6-1934	Ice	Ice	Safety C. H. & L.	.....	1	5	Motor	Body	None	....	....	....
D. & R. G. W.	5	Diners	6-1934	Ice	Ice	.....	.....	1	3.2	Flat belt	Body	Edison	520	....	....
	7	Obs.-lounge	6-1934	Ice	Ice	.....	.....	1	3.2	Flat belt	Truck	Edison	480	....	....
Erie	14	Coaches	7-1934	St. eject.	Water	Safety C. H. & L.	.....	2	4	Flat belt	Body	Edison	675	....	....
	2	Coach-buffet	7-1934	St. eject.	Water	Safety C. H. & L.	.....	2	4	Flat belt	Body	Edison	675	....	....
	2	Diners	7-1934	St. eject.	Water	Safety C. H. & L.	.....	2	4	Flat belt	Body	Edison	750	....	....
	1	Business	7-1934	St. eject.	Water	Safety C. H. & L.	.....	2	4	Flat belt	Body	Edison	900	a. c.	220-440
	1	Business	8-1934	St. eject.	Water	Safety C. H. & L.	.....	1	4	Flat belt	Body	Edison	900	a. c.	220-440
								1	10	Flat belt	Body				
Great Northern	1	Business	7-1934	Ice	Ice	R. R. Co.	.....	1	4	Gear	Body	Exide	600	....	....
	10	Diners	4-1934	Ice	Ice	P. C. & M. C.	.....	1	5	Gear	Body	Exide	600	....	....
	2	Diners	4-1934	Ice	Ice	P. C. & M. C.	.....	1	4	Gear	Body	Exide	350	....	....
Lehigh Valley	2	Diners	1934	Mech.	Freon	Frigidaire	Motor	1	10	Flat belt	Body	Exide	1,000	a. c.	220
								1	5	Flat belt	Body	Exide	1,000	a. c.	220
L. & N.	8	Diners	8-1934	St. eject.	Water	Safety C. H. & L.	.....	1	7.5	Flat belt	Body	Exide	800	....	....
Maine Central	2	Comb.	6-1934	Ice	Ice	B. F. Sturtevant Co.	.....	1	4	Flat belt	Body	Exide	300	....	....
	5	Coaches	7-1934	Ice	Ice	B. F. Sturtevant Co.	.....	1	4	Flat belt	Body	Exide	300	....	....
M-K-T	4	Diners	1934	St. eject.	Water	Safety C. H. & L.	.....	1	5	V-belt	Body	2 Exide	1,000	....	....
								1	4	Flat belt	Body	2 USL	1,000	....	....
Missouri Pacific	1	Business	3-1934	Mech.	Freon	Frigidaire	Motor	1	10	Gear	Body	Gould	2,000	....	....
								1	20	Gear	Truck	.....	.....	a. c.	220
	2	Coach-parlor	8-1934	St. eject.	Water	Safety C. H. & L.	.....	2	4	Flat belt	Body	Edison	1-600	....	....
													1-750	....	....
	1	Lounge	6-1934	St. eject.	Water	Safety C. H. & L.	.....	2	4	Flat belt	Body	Edison	750	....	....
	3	Lounge-diners	6-1934	Mech.	Freon	Westinghouse	Motor	1	15	Gear	Truck	Edison	900	a. c.	220
	2	Lounge-diners	6-1934	Mech.	Freon	Frigidaire	Motor	1	15	Gear	Truck	Edison	900	a. c.	220
	2	Lounge-diners	6-1934	Mech.	Freon	Frigidaire	Motor	1	15	V-belt-gear	Body	Gould	1,000	a. c.	220
	1	Diner	6-1934	Mech.	Freon	Frigidaire	Motor	1	15	Gear	Truck	Edison	900	a. c.	220
	3	Lounge-diners	6-1934	St. eject.	Water	Safety C. H. & L.	.....	2	4	Flat belt	Body	Edison	750	....	....
	3	Lounge-diners	6-1934	Ice	Ice	.....	.....	1	4	Flat belt	Body	Edison	375	....	....
	3	Parlor	6-1934	Ice	Ice	.....	.....	1	4	Flat belt	Body	Edison	375	....	....
	4	Coach-club	6-1934	Ice	Ice	.....	.....	1	4	Flat belt	Body	Edison	375	....	....
	1	Business	7-1934	Ice	Ice	.....	.....	2	4	Flat belt	Body	Edison	900	....	....
N. C. & St. L.	2	Diners	7-1934	St. eject.	Water	Safety C. H. & L.	.....	1	7½	Flat belt	Body	Edison	852	....	....
	3	Cafe-parlor	1934	St. eject.	Water	Safety C. H. & L.	.....	1	7½	Flat belt	Body	Edison	852	....	....
N. Y. Central	9	Coaches	7-1934	Mech.	Freon	Frigidaire	Motor	1	20	Gear	Truck	USL and Gould	450 at 64 V	....	.....
	6	Diners	7-1934	Mech.	Freon	Frigidaire	Motor	1	20	Gear	Truck	USL	600 at 64 V	....	.....
	22	Coaches	5-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	USL and Gould	450	a. c.	220
	32	Diners	5-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	5	Flat belt	Body	Exide	600 at 64 V	a. c.	220

Air-Conditioned Passenger Cars Placed in Service Since January 1, 1934 (Continued)

Railroad	No. of cars	Type of car	Date equipped	Type of system	Refrigerant	Manufacturer of system	Compressor drive	Generators: No.	Generators: Capacity, kw.	Generators: Type of drive	Generators: Type of mounting	Storage batteries: Make	Storage batteries: Amp.-hr. capacity[1]	Outside power supply: a. c. or d. c.	Outside power supply: Volts
N. Y. C. (B. & A.)	4	Diners	5-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	5	Flat belt	Body	Edison	450 at 64 V	a. c.	220
N.Y.C.& St.L. (Nickel Plate)	1	Business	3-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	2	4	Flat and V-belt	Body	Edison	1,024	a. c.	220
N. Y., N. H. & H.	14	Diners	6-1934	Ice	Ice	B. F. Sturtevant Co.	.....	..	....	.....	.....	.....	.....	....	....
	9	Comb.	6-1934	Mech.	Freon	Safety C. H. & L.	Motor	2	1-4 1-15	Flat belt V-belt-gear	Body Body	Exide	1.000	....	....
	6	Smoker	6-1934	Mech.	Freon	Safety C. H. & L.	Motor	2	1-4 1-15	Flat belt V-belt-gear	Body Body	Exide	1,000	....	....
	27	Coaches	6-1934	Mech.	Freon	Safety C. H. & L.	Motor	2	1-4 1-15	Flat belt V-belt-gear	Body Body	Exide	1,000	....	....
N. & W.	7	Diners	6-1934	Mech.	Freon	Frigidaire	Motor	1	15	V-belt	Truck	Edison	300 at 110 V	a. c.	220
Northern Pacific	10	Obs.	6-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	5 Exide 5 Gould	570 570	a. c.	220
	9	Diners	6-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	5	Flat belt	Body	Exide	570	a. c.	220
Pennsylvania	25	Diners	1934	Mech.	Freon	Frigidaire	Motor	1	15	Gear	Truck	.....	800	....	....
	5	Diners	1934	Mech.	Freon	Frigidaire	Motor	1	15	V-belt-gear	Body	.....	800	....	....
	37	Coaches	1934	Ice	Ice	R. R. Co.	.....	1	4.8	Flat belt	Body	.....	500	....	....
	27	Comb.	1934	Ice	Ice	R. R. Co.	.....	1	4.8	Flat belt	Body	.....	500	....	....
	18	Coaches	1934	Ice	Ice	R. R. Co.	.....	1	4.8	Flat belt	Body	.....	500	....	....
	1	M. u. coach	1934	Mech.	Freon	Baldwin-Southwark	Motor	..	....	.....	.....	None	.....	....	....
	1	Coach	1934	Mech.	Freon	Frigidaire	V-belt from axle	1	4.8	Flat belt	Body	.....	800	....	....
	1	Coach	1934	Mech.	Freon	York	Motor	1	10	V-belt	Body	.....	800	....	....
	1	Coach	1934	Mech.	Freon	General Electric	Motor	1	15	Gear	Truck	.....	800	....	....
Pullman Co.	12	Parlor-obs.	1934	St. eject.	Water	Safety C. H. & L.	.....	1	4	V-belt	Body	Exide	550	....	....
	13	Parlor-obs.	1934	Mech.	Freon	P. C. & M. C.	Motor	2	1-4 1-15	V-belt V-belt-gear	Body Body	Exide	1,000	....	....
	68	Parlor-obs.	1934	Ice	Ice	Pullman	.....	1	4	V-belt	Body	Exide	600	....	....
	7	Parlor	1934	Mech.	Freon	P. C. & M. C.	Speed Reducer	1	4	V-belt	Body	Exide	550	....	....
	47	Parlor	1934	Mech.	Freon	P. C. & M. C.	Motor	2	1-4 1-15	V-belt V-belt-gear	Body Body	Exide	1,000	....	....
	110	Parlor	1934	Ice	Ice	Pullman	.....	1	4	V-belt	Body	Exide	600	....	....
	34	Composite	1934	St. eject.	Water	Safety C. H. & L.	.....	2	4	V-belt	Body	Exide	850	....	....
	81	Composite	1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	V-belt	Body	Exide	550	....	....
	33	Composite	1934	Mech.	Freon	P. C. & M. C.	Motor	2	1-4 1-15	V-belt V-belt-gear	Body Body	Exide	1,000	....	....
	74	Composite	1934	Ice	Ice	Pullman	.....	1	4	V-belt	Body	Exide	600	....	....
	260	Sleepers	1934	Ice	Ice	Pullman	.....	1	4	V-belt	Body	Exide	600	....	....
	23	Sleepers	1934	St. eject.	Water	Safety C. H. & L.	.....	2	4	V-belt	Body	Exide	850	....	....
	288	Sleepers	1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	V-belt	Body	Exide	550	....	....
	111	Sleepers	1934	Mech.	Freon	P. C. & M. C.	Motor	1	4	V-belt	Body	Exide	1,000	....	....
Reading Co.	1	Club-coach	7-1934	Mech.	Freon	York	Motor	2	1-4 1-7½	Flat belt Flat belt	Body Body	Exide	1,000	a. c.	220-440
	2	Cafe	7-1934	Mech.	Freon	York	Motor	2	1-4 1-7½	Flat belt Flat belt	Body Body	1 Exide 1 USL	1,000 1,000	a. c.	220-440 220-440
		Comb.	7-1934	Mech.	Freon	York	Motor	2	1-4 1-7½	Flat belt Flat belt	Body Body	Exide	1,000	a. c.	220-440
	4	Coaches	7-1934	Mech.	Freon	York	Motor	2	1-4 1-7½	Flat belt Flat belt	Body Body	3 Exide 1 USL	1,000	a. c.	220-440
R. F. & P.	2	Coaches	8-1934	Mech.	Freon	West.-Frigidaire	Motor	1	15	Gear	Truck	Edison	300[3]	a. c.	220
	1	Parlor-cafe	9-1934	Mech.	Freon	West.-Frigidaire	Motor	1	15	Gear	Truck	Edison	450[3]	a. c.	220
	2	Diners	10-1934	St. eject.	Water	Safety C. H. & L.	.....	1	10	V-belt-gear	Body	Edison	1-600 1-750	....	....
	2	Diners	11-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	Edison	1-600 1-375	....	....
Seaboard A. L.	1	Parlor-diner	4-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	Edison	300	a. c.	220
	2	Obs.-diners	5-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	Edison	375	a. c.	220
	3	Coach-diners	4-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	Edison	375	a. c.	220
	5	Comb.	5-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	3	Flat belt	Body	Edison	300	a. c.	220
	5	Coaches	4-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	3	Flat belt	Body	Edison	300	a. c.	220
	2	Diners	4-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	Edison	375	a. c.	220
	8	Diners	1-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	Edison	375	a. c.	220

Air-Conditioned Passenger Cars Placed in Service Since January 1, 1934 (Continued)

Railroad	No. of cars	Type of car	Date equipped	Type of system	Refrigerant	Manufacturer of system	Compressor drive	Generators: No.	Generators: Capacity, kw.	Generators: Type of drive	Generators: Type of mounting	Storage batteries: Make	Storage batteries: Amp.-hr. capacity[1]	Outside power supply: a. c. or d. c.	Outside power supply: Volts
St. L.-S. F.	5	Coaches	1934	Ice	Ice	R. R. Co.	.....	1	3	Flat belt	Body	Exide	450	....	....
	2	Chair	1934	Ice	Ice	R. R. Co.	.....	1	3	Flat belt	Body	Exide	450	....	....
	2	Lounge	1934	Ice	Ice	R. R. Co.	.....	2	4	Flat belt	Body	Exide	900	....	....
	2	Club-coach	1934	Ice	Ice	R. R. Co.	.....	2	1-3 1-4	Flat belt Flat belt	Body	Exide	900	....	....
	1	Lounge-diner	1934	Ice	Ice	R. R. Co.	.....	2	1-3 1-4	Flat belt Flat belt	Body Body	Exide	900	....	....
Sou. Pac.	4	Obs.	6-1934	Ice	Ice	R. R. Co.	.....	1	5	3 Flat belt	Body	Edison	750	....	....
								1	4	1 V-belt	Truck	Edison	450	....	....
	2	Chair	6-1934	Ice	Ice	R. R. Co.	.....	1	4	Flat belt	Body	Edison	450	....	....
	4	Club	6-1934	Ice	Ice	R. R. Co.	.....	1	4	Flat belt	Body	Edison	450	....	....
	3	Lounge	6-1934	Ice	Ice	R. R. Co.	.....	1	5	Flat belt	Body	Edison	750	....	....
	5	Diners	6-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	Edison	450	a. c.	220-240
Union Pac.	16	Diners	6-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	Edison	375	a. c.	220
	22	Obs.	6-1934	Mech.	Freon	P. C. & M. C.	Speed reducer	1	4	Flat belt	Body	19 Exide 3 Edison	500 375	a. c.	220
Wabash	2	Cafe-parlor	7-1934	Ice	Ice	R. R. Co.	.....	1	4	Flat belt	Body	Exide	350	....	....
	7	Chair	6-1934	Ice	Ice	R. R. Co.	.....	1	3	Flat belt	Body	Exide	350	....	....
	5	Cafe-Lounge	7-1934	Ice	Ice	R. R. Co.	.....	1	4	Flat belt	Body	Exide	350	....	....
Western Pac.	4	Diners	6-1934	St. eject.	Water	Safety C. H. & L.	.....	2	9	Flat belt	Body	Edison	750	....	....

[1]All batteries shown are 32 volts, except where otherwise noted.
[2]Two units of streamlined train "Zephyr."
[3]Compressor does not operate from batteries.

Summary of types of Systems and Refrigerants Used

Type of System

Railroad	No. cars	Electro-mech.	Direct-mech.	Ice	Steam ejector	Refrigerant used: Freon	Water	Ammonia	Methyl-chl.
Alton	8	8	...	...	...	8	...	...	...
Atlantic Coast Line	7	...	...	...	36	...	36	...	...
Atchison, Topeka & Sante Fe	36	...	...	...	7	...	7	...	...
Boston & Maine	10	...	...	10	...	...	10	...	...
Baltimore & Ohio	59	59	...	...	...	59	...	...	...
Chesapeake & Ohio	6	...	6	...	...	6	...	...	...
Chicago, Burlington & Quincy	25	8	...	17	...	8	17	...	...
Chicago & Eastern Illinois	4	...	...	2	2	...	4	...	...
Chicago, Milwaukee, St. Paul & Pacific	22	...	...	...	22	...	22	...	...
Chicago & North Western	17	1	...	16	...	...	16	...	1
Chicago, Rock Island & Pacific	17	...	...	5	12	...	17	...	...
Delaware, Lackawanna & Western	9	...	...	9	...	...	9	...	...
Denver & Rio Grande Western	12	...	...	12	...	...	12	...	...
Erie Railroad	20	...	...	...	20	...	20	...	...
Great Northern	13	...	...	13	...	...	13	...	...
Lehigh Valley	2	2	...	...	...	2	...	...	...
Louisville & Nashville	8	...	...	...	8	...	8	...	...
Maine Central	7	...	...	7	...	...	7	...	...
Missouri-Kansas-Texas	4	...	...	...	4	...	4	...	...
Missouri Pacific	26	9	...	11	6	9	17	...	...
Nashville, Chattanooga & St. Louis	5	...	...	...	5	...	5	...	...
New York Central	69	15	54	...	...	69	...	...	...
New York Central (B. & A.)	4	...	4	...	...	4	...	...	...
Nickel Plate	1	...	1	...	...	1	...	...	...
New York New Haven & Hartford	56	42	...	14	...	42	14	...	...
Norfolk & Western	7	7	...	...	...	7	...	...	...
Northern Pacific	19	...	19	...	...	19	...	...	...
Pennsylvania Railroad	116	34	...	82	...	34	82	...	...
Pullman	1161	204	376	512	69	580	581	...	...
Reading Company	9	9	...	...	...	9	...	...	...
Richmond, Fredericksburg & Potomac	7	3	2	...	2	5	2	...	...
Seaboard Air Line	26	...	26	...	...	26	...	...	...
St. Louis-San Francisco	12	...	...	12	...	...	12	...	...
Southern Pacific	18	...	5	13	...	5	13	...	...
Union Pacific	38	...	38	...	...	38	...	...	...
Wabash	14	...	...	14	...	...	14	...	...
Western Pacific	4	...	...	...	4	...	4	...	...
TOTAL	1878	401	531	749	197	931	946	0	1

Motive Power Requirements For High-Speed Trains[1]

Part I

By G. I. Wright[2] and P. A. McGee[3]

Relative operating costs of main-line and suburban passenger trains with steam, electric and oil-electric motive power

DESPITE recent publicity and developments in the design of light-weight equipment and internal-combustion motive power for high-speed passenger trains, there has been little, if any, published analysis of the motive-power requirements and economics involved in the operation of trains of various sizes, shapes and weights at high speeds, say for 75 to 125 m.p.h.

The first step necessary in such analysis is to establish rational definitions for the most important dimensions of a train. The quantity of passenger transportation produced is usually expressed in "passenger-train miles" or "car miles." When it is recognized that trains may vary in length from 50 ft. to 1,500 ft. and cars from 50 ft. to 80 ft. with corresponding variations in weight, it is seen that these indices give no real measure of transportation. "Passenger-seat miles" is equally unsatisfactory as the linear space occupied per seat varies from 9 in. to 2 ft. or over.

The motive power supplies energy to accelerate a train, to overcome air and frictional resistance and to ascend grades. Air resistance at any speed is a function of the cross-section area and shape of a train together with its length, while frictional resistance is proportional to weight. Accelerating and gravity forces on grades are also proportional to weight. Remembering that the motive power itself usually occupies some of the total train length, we then have four important physical dimensions of a passenger train as follows:

1—Total length, including that of the motive power unit.
2—Net length available for passengers, mail or baggage.
3—Average weight per foot of gross length.
4—Average weight per foot of net length.

Assumptions and Tractive Resistance Values

With these ruling dimensions we are in a position to study the effects of train shape and weight on the tractive resistance of any length train running at any practicable speed.

We will consider both conventional and light-weight rolling stock. With each we will assume two types of construction, namely conventionl design and revised design with specially shaped ends which cause a considerable reduction in head-end and tail-end air resistance.

With these two types of trains and the two end formations, tractive resistance values for any length train may be calculated according to recognized formulae. The principal data of types of rolling stock and weight characteristics of different types of motive power to be considered in this study are as follows:

1—Conventional Passenger Coach.—Height from rail, 13 ft. 6 in. to 14 ft.; width, 10 ft.; front area, 120 sq. ft.; circumference, 41 ft.; weight per foot, 2,000 lb. for main line and 1,200 to 1,400 lb. for suburban; load, per foot, 400 lb.

2—Light-Weight Passenger Coach.—Height from rail, 11 ft.; width, 8 ft. 9 in.; front area, 100 sq. ft.; circumference, 32 ft.; weight per foot, 700 to 800 lb. for main line or suburban; load per foot, 400 lb.

3—Steam Locomotive.—Weight per horsepower at driving wheels of locomotive with tender, including fuel and water, 200 lb. for main line and 150 lb. for suburban; horsepower per foot of locomotive and tender, 20 to 30.

4—Electric Locomotive.—Weight per horsepower (continuous rating) at driving wheels, 100 lb.; horsepower per foot, 50 to 60.

5—Electric MU Equipment.—Weight per horsepower at driving wheels, 50 lb.

6—Oil-Electric Equipment.—Including fuel, water and accessories, 100 lb. per horsepower at driving wheels, or 25 to 35 hp. per foot.

Total train resistance is made up of three combinations: First, journal friction, rolling and track resistances; second, flange friction, car oscillation and swaying, and third, air drag and wind effects. Their values are greatly influenced by atmospheric conditions, temperature, condition of track and type of vehicle. For any given set of conditions the first combination is considered constant and independent of speed. This resistance, however, is a function of axle bearing pressure and decreases with increase in axle load. The second combination varies directly with the speed. It is influenced by the truck wheel base, steadying effect of a trailer load and effect of track on body oscillations and swaying. The third combination includes all air effects. For general purposes it is assumed that the resistance is caused by the train moving at a given speed through still air. Physical properties of the train which affect this resistance are area and shape of front and rear ends, length of train, nature of surfaces and frequency and nature of car connections. This combination is proportional to the square of the speed and is of great importance at high speeds.

The total train resistance may be represented by an equation including the above three factors as follows:

$$R = A + BV + CV^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where R = total resistance
A = constant depending on axle weight
B = constant depending on conditions outlined
C = constant depending on conditions outlined
V = Speed

Representative values for constants *A* and *B* for given train weights per foot are shown on Curve 3 for good track conditions and at a temperature of 60 deg. F. These constants have been taken from values proposed by Davis.[4]

Values for constant *C* requires more consideration. Air effects on trains are made up of four parts; head end and rear effects and skin and eddy effects on the longitudinal surfaces. From a purely aerodynamic standpoint, no such simple segregation can be made. For a stream-lined body it is necessary to consider the structure as a whole with reference to the air flowing around it. Under the conditions of a perfectly stream-lined

[1] Abstract of a paper presented before the New York Railroad Club, October 19, 1934.
[2] Chief electrical engineer, Reading Company.
[3] Assistant engineer, Reading Company.

[4] W. J. Davis, Jr., Tractive Resistance of Electric Locomotives and Cars. General Electric Review, October, 1926.

train which would be shaped like a dirigible, automobile or street car where an approximation to perfect streamlining may be obtained without introducing an abnormal height. However, with a long train there is little possibility of even approaching a perfect stream-line formation and tests by Goldsborough in 1906 and Schmidt and Dunn of the University of Illinois, confirm the feasibility of considering the air resistance effect in the constituent parts named. For convenience in estimating, the usual resistance formulas developed for conventional trains give a constant which, when multiplied by the front area for the front coach or locomotive and trailing coaches gives the total resistance of the train. This assumption is correct only when there is a definite relation between front area and length of individual coaches.

The air resistance coefficients developed by Goldsborough for various types of car ends were as follows for single cars:

Flat ends	.00340
Standard ends	.00225
Parabolic ends	.00120
Parabolic wedge ends	.00113

Other authorities give values for ends, not perfectly described, varying between .0027 and .0024. These coefficients when multiplied by the front-end area give the total front and rear resistance together with the skin and eddy resistances of the car. Tests by Schmidt and Dunn for trailer cars give skin and eddy effect coefficients varying between .0000162 for 58-ft. cars to .0000146 for 70-ft. cars, all having an end cross section of 120 sq. ft.

Skin and eddy resistance of the head vehicle is probably different from that of succeeding cars, but for speeds obtained today the resistance of trailer cars may be looked upon as equal when similarly dimensioned with the exception of the rear car. With this understanding it is permissible with present rolling stock and trains of at least two cars, to consider the front and rear resistance coefficient separately from the skin and eddy coefficient.

Accepting the average developed coefficients, the following values are obtained:

Total air resistance conventional cars	=	$.0024aV^2$	(2)
Total air resistance special-shaped cars	=	$.0012aV^2$	(3)
Skin and eddy resistance standard vestibule cars	=	$.00001464bV^2$	(4)

Where a = Area of front and rear ends of car.
b = Area of car langitudinal surfaces.
V = Speed in miles per hour.

Taking the average circumference of a standard car as 41 ft. and of a light-weight car as 32 ft. the skin and eddy effects may be deducted from equation 2 and 3 with the following results for total front and rear air resistance.

Conventional train and ends	=	$.246V^2$	(5)
Conventional train with special ends	=	$.101V^2$	(6)
Light-weight train with conventional ends	=	$.207V^2$	(7)
Light-weight train with special ends	=	$.087V^2$	(8)

With equations 5 to 8 inclusive we can estimate front and rear air resistances and with equation 4 skin and eddy resistance per foot of any train section or average circumference above some minimum length with surface conditions such as exist with standard vestibule cars of 70 ft. length. With these equations for air resistance and Curve 3 for friction and flange resistance, curves for the total resistance of trains on a length basis may be constructed, as shown in Curve 1.

Curve No. 1

The top portion of Curve 1 gives constant resistance *A* commonly called "journal resistance." This resistance is given on a weight per foot and length basis; the weight per foot being the average weight for the total train and the length the total train length including motive power.

The centre set of curves gives variable friction factor *B* commonly called "flange resistance," which varies as a function of the speed. This resistance also is given on a weight per foot and length basis.

The bottom portion gives air resistance factor *C* for various train lengths of four different types.

Due to the possibility of irregularities occurring in air coefficients with trains shorter than 100 ft. this is the minimum length shown. It should also be noted that Curve 1 does not attempt to give air resistance factors for radical stream-lining.

The air resistance with conventional coaches and specially shaped train ends and small-size coaches with special train ends are shown in Table I as a percentage of the conventional standard-end train.

Table I—Percentage of Air Resistance per Foot with Different Type Coaches

Total train length	Conventional coaches		Small-size coaches special ends
	Standard ends	Special ends	
100 ft.	100	53.4	46.6
500 ft.	100	73.4	57.8
1,000 ft.	100	83.4	64.6

The reduction in air resistance per foot by increasing the length of train for both standard and special-ends is shown in Table II.

Table II—Percentage of Air Resistance per Foot with Different Length Trains

Total train length	Train with standard ends	Train with special ends
100 ft.	100	100
500 ft.	36.7	44.6
1,000 ft.	28.0	40.5

Reduction in air resistance obtained with reduced-size coaches and special shaped ends may possibly be increased by refinement in train surfaces, attention to shape and connections between coaches. Such further reduction, however, cannot be considerable, as resistance caused by eddies along the longitudinal surfaces of the train which is the principal force affected by formation and shape of train sides, is relatively a small part of total train resistance.

With due allowance for increase in friction with decrease in axle load, the reduction in journal and variable friction resistance is considerable with reduction in weight. As an example, consider a conventionl steam train with an average weight of 3,000 lb. per gross foot and a total length of 600 ft. in comparison with a light-weight electric motor-car train weighing 1,250 lb. per foot and having an overall length of 500 ft. At 100 m.p.h. total friction resistances of the two trains are:

Conventional steam train	5,280 lb.
Light-weight electric train	2,300 lb.

The difference of 2,980 lb. at 100 m.p.h. represents practically 800 hp. and this saving is directly obtained with light-weight motive power equipment and light-weight coaches.

Consider now the air resistances of these two trains of 600 ft. and 500 ft. respectively at 100 m.p.h.:

Conventional steam train	6,000 lb.
Light-weight electric train	3,150 lb.

The difference of 2,850 lb. at 100 m.p.h. represents 760 hp. which is actually less than the saving obtained with reduced friction resistance.

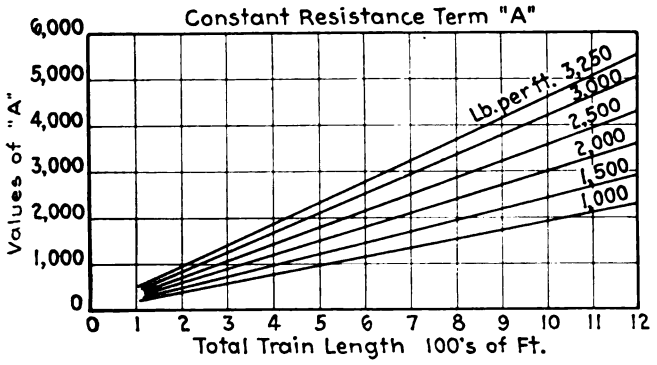
From these considerations it may be concluded that the most practical way to reduce train resistance at high speeds is to run trains at maximum length, i. e., consolidate as many trains as possible into one, reduce the cross section and the weight to a minimum. Where, however, high speeds are required with trains of short

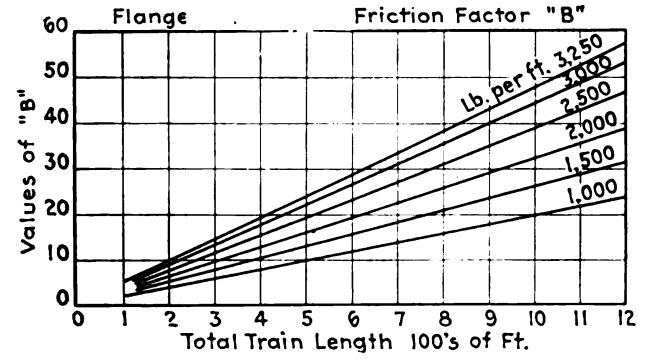
length the shaping of the ends is important. Effects of tractive resistance on varying train length can be best illustrated by considering horsepower requirements per foot of net train lengths at various speeds.

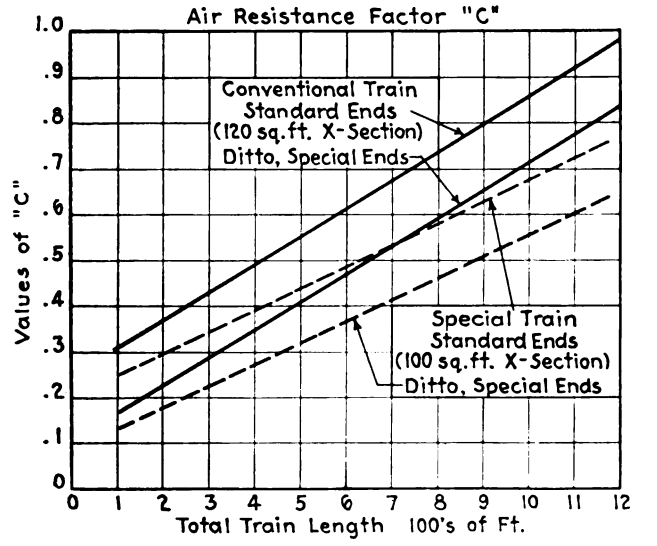
Train Characteristics

The most important operating indices of main-line trains with comparatively long distances between stops and few slow downs are free running speed on level tangent track, free running speed on the ruling grade and the rate of acceleration at high speed. These three indices explain the operating possibilities of any main-line train with a given permissible maximum speed and rate of braking.

With all types of motive power the initial rate of acceleration is limited only by adhesive weight. As the speed increases, however, the rate of acceleration is limited by the available power, which in the case of the steam locomotive is boiler capacity; in the oil-electric,

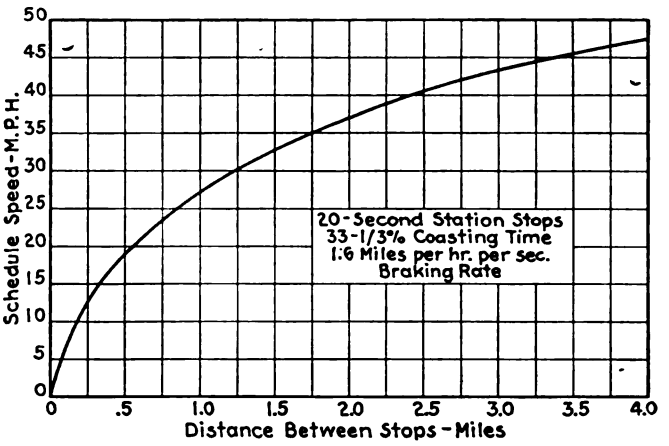




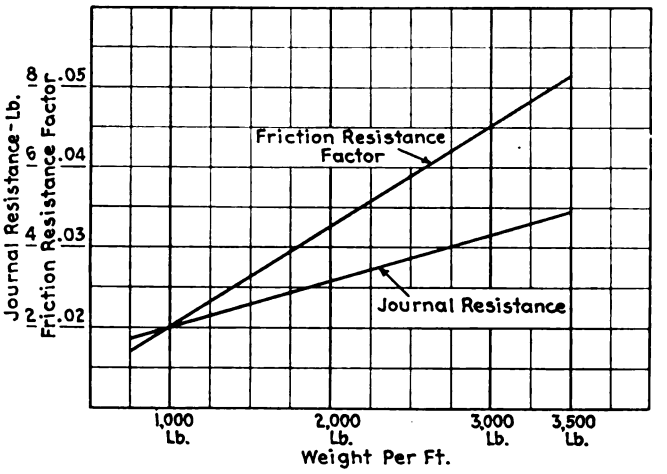


$R = A + BX + CV^2$
R = Total resistance, lb.
V = Speed, m.p.h.

Curve 1—Train resistance values



Curve 2—Suburban train schedule speeds



Curve 3—Journal and friction resistance values

the shaft horsepower, and in the electric, the available power of the distribution lines. With electric power supplied from a large available source of energy, it is normally possible to carry the initial rate of acceleration to quite high speeds, the only limitation being adhesive weight. In order fully to exploit this available energy with electric power it is necessary to use as much of the total train weight as possible for tractive adhesion and in consequence it becomes desirable to distribute the traction motors throughout the train, or, in other words, employ distributed motive power.

With these considerations in mind the most instructive analysis and comparison can be made with (1) head-end steam power as employed with conventional steam trains; (2) head-end electric power as employed on main-line trains; (3) distributed electric power as employed with suburban motor-car trains, and (4) distributed or concentrated oil-electric power built into the train or coach structure.

Further considerations will be confined to two types of coaches, namely, trains with conventional coaches and standard-shaped ends and trains with small-size coaches and special-shaped ends. These are the two extreme cases shown on Curve 1 and whose characteristics have already been given.

We will now develop characteristic curves of horsepower required per net foot of train length for the three types of motive power and two types of coaches to obtain free running speeds on level track of 70, 85, 100, and 125 m.p.h. and further show the free running speeds on a ruling grade of 0.5 per cent and the rate of train acceleration in miles per hour per second on level track at the speed where electric power would normally

commence to decrease its horsepower output. It should be noted that the horsepower considered is at the rims of the driving wheels which should not be confused with steam-locomotive indicated horsepower or oil-electric shaft brake horsepower.

Curves marked *A* show required horsepower per net train foot at the driving wheels to obtain the free running speed considered. These curves do not show values for head-end electric power which lie between the steam and oil-electric curves at 70 m.p.h. free running speed and on or slightly below oil-electric curves at the other speeds.

Table III shows effects of length on horsepower which may be read from the *A* curves. With a 500-ft. train the required horsepower per net foot varies between 44 and 60 per cent of that required with 100-ft. trains. With 1,000-ft. trains the required horsepower per foot is between 36 and 58 per cent of the 100 ft. train.

Table III—Effect of Net Train Length on Required Horsepower per Foot

Net train length	Horsepower as a percentage of 100-ft. train
100 ft.	100
500 ft.	44 to 60
1,000 ft.	36 to 58

Table IV shows the effect of free running speed on required horsepower between limits shown on the *A* curves for different types of power considered. The increase in horsepower required to increase free running speed from 70 to 125 m.p.h. is, with 100-ft, trains, from 5 to 6.3 times and with 1,000-ft. trains from 4.2 to 4.6 times. To increase free running speed from 70 to 85 m.p.h., or from 85 to 100 m.p.h would require an increase of from 50 to over 70 per cent in the motive-power rating.

Table IV—Effect of Speed on Required Horsepower per Net Foot Horsepower Is Referred to that Required at 70 m.p.h.

Speed	100-ft. train	500-ft. train	1,000-ft. train
70 m.p.b.	100	100	100
85 m.p.h.	150 to 170	150 to 157	150 to 155
100 m.p.h.	256 to 295	250	230
125 m.p.h.	500 to 634	430 to 500	420 to 460

In order to interpret properly the characteristics shown on the *A* curves, it is necessary to consider the free running speed of the various trains on some ruling grade which we are taking at 0.5 per cent and also to note the rate of acceleration at high speeds.

Free Running Speed and Acceleration at High Speed

These values are shown for various trains and train lengths in the *B* series of curves. Since there is little difference between conventional and light-weight trains, only one curve is shown for each type of power. Free running speeds and rates of acceleration shown on the *B* curves were obtained by assuming the same horsepower as on *A* curves with the exception of electric power accelerating rates where a horsepower output 65 per cent greater than that shown on the *A* curves is assumed. This is the normal overload taken by electric motors during accelerating periods. Values for head-end electric power are not shown as they are practically the same as for distributed electric power.

Referring to series *B* curves, there is a gradual decrease in free running speeds on the 0.5 per cent grade with increase in train length. The drop in free running speed is a maximum with trains of lowest free running speed on the level.

Rates of acceleration shown by the lower series of *B* curves, at the speeds selected, decrease with increase in train length and increase with increase in train free running speed. Speeds at which rates of acceleration are given are as follows: *B1* curves, 30 m.p.h.; *B2* curves, 38 m.p.h.; *B3* curves, 45 m.p.h.; *B4* curves, 55 m.p.h.

The relatively low rates of acceleration with steam and oil-electric power which are never above half those obtained with electric power, is a characteristic difference between self-contained motive power and motive power connected to a large source of power.

In many main line services the accelerating rate at high speeds and free running speeds on grades are more important than the ultimate free running speed on level track. Under such conditions air resistance values and streamlining are of relatively small importance. This explains why tractive resistance formulas which give widely different values result apparently in similar overall train performances.

In a general study of relative train performance it is difficult to include these variable factors as they are the result of local conditions which vary in each case. In consequence we will confine further considerations to the *A* curves and compare relative train performances on the single power requirement to obtain a free running speed on level track.

Operating Costs

The most satisfactory evaluation of the characteristics shown on the *A* curves may be obtained by considering operating costs of such items as are affected by the type of motive power.

The *A* curves give power requirements in horsepower per ft. of net train length. There is, of course, a great lack of flexibility in motive power, particularly when concentrated at the head end, as there is just one train size where motive power is operated at maximum efficiency. With distributed power, which is shown for electric operation on the *A* and *B* curves, there is considerably more flexibility, but here again, the exact assignment of power will be dictated by the minimum size train which it is proposed to operate at any given free running speed. Under normal operating conditions it would not be possible to secure the exact required motive power and generally it may be expected that an excess will be obtained, just as obtains today with the average steam train. In this estimate, however, it will be assumed that the theoretically exact power requirements as shown in the *A* curves, are obtained and all cost data is made on this basis.

The most important items of operating cost which are effected by size, speed, shape and motive power of trains are: Fuel and power, crew, train supplies, terminal charges, engine house, maintenance and fixed charges.

[For curves *A* and *B* see Part II—Editor]

* * *

A New Lullaby.—A delicate tribute to railroad sleeping cars is paid by Professor Salomon, a German inventor, who has just produced a new sleep-inducing machine, according to the Delaware & Hudson Railroad Bulletin. The machine consists of a plain wooden box, mounted on three little legs, and contains a clockwork mechanism that runs for 40 min., emitting a hollow droning sound punctuated by a dull clicking. Prospective purchasers of this antidote for insomnia are told to imagine themselves in a sleeping car, being lulled to sleep by the "clicks from the rails."

This reminds us of a story by Irvin S. Cobb. After returning from a long lecture tour, involving nightly "sleeper jumps," the noted humorist found that he could not sleep in his own home. He finally solved the problem, though. Upon retiring each night, he put a cinder in his eye and had someone shake his bed violently every few minutes. Then he slept perfectly.

EDITORIALS

The 1934 Index

The preparation of the index for the 1934 volume of the *Railway Mechanical Engineer* will have begun when you receive this issue. Copies of the index are mailed only to those subscribers who desire it. Send us your name and address promptly if you did not write for the 1933 index.

Trends in Motive Power

While purchases of locomotives and rolling stock have been insignificant since 1930, the inventory has not been standing still. Retirements of locomotives have been continued throughout the depression at rates not greatly below those prevailing before the depression. As a result there has been a sharp increase in the rate of decline in the number of units. The decline actually began in the middle 1920's, but until the sharp recession in equipment installations in 1931 it was causing little real change in the aggregate available capacity.

Installations of locomotives averaged 1,405 units per year from 1925 to 1930, inclusive, and retirements were at the average rate of 2,890 units per year. There was a decline from 63,974 locomotives owned by the Class I railways at the end of 1925 to 56,582 at the end of 1930. The aggregate tractive force, however, had declined only 60 million pounds from 2,587 million pounds. At the end of 1933, after three years of installations at the average rate of 407 a year and retirements at 2,599 a year, the number of locomotives had declined to 50,802. This decline is about three-fourths as great as that during the preceding six years, but the decline in aggregate tractive force was about 147 million pounds—nearly six per cent in three years.

This represents a definite cleaning up of the inventory. The locomotives retired have been of types which have largely ceased to have any place except in light service. The retirements have little relation to the policies which the railways are developing with respect to the purchase of new equipment when a restoration of traffic and earnings permits them to take up seriously the question of major capital expenditures. They are evidence of a clear recognition of obsolescence at the bottom of the inventory, during a period when curtailed traffic has removed the immediate need for more aggregate equipment capacity and when vanished earnings and credit have made major capital expenditures impossible.

In the reports to Co-ordinator Eastman's Car Pooling Section, as of October 1, 1933, there were 1,046 road locomotives having four-wheel trailer trucks, a characteristic which may be employed roughly to distinguish strictly modern locomotives from those not strictly modern in construction. In the middle group the numerically important freight types are the 2-8-2 and the 2-10-2, of which there are 9,830 and 2,054, respectively. The 4-6-2 and 4-8-2 types, of which there were 5,528 and 1,809, respectively, are the important groups of passenger power and are also used to a limited extent in freight service. It is locomotives from these groups which are being replaced in main-line service by locomotives with the four-wheel trailers, which develop higher sustained horsepower and maintain higher sustained speeds than can be obtained from those now generally employed. There is little place, except on light branch lines, for the locomotives of 4-4-0, 2-6-0, 4-6-0, 2-8-0 and 4-8-0 types, but there were over 18,000 of these locomotives still carried in the property account at the time of the report—groups which have long ceased to be purchased and the average ages of which were from 26 to 34 years. To these may be added the 4-4-2 and 2-6-2 types, making a total of nearly 20,000 units. These are the locomotives which were the least used during the period studied by the Co-ordinator.

These figures, which are also set forth in the table, present a composite picture of a situation which varies

The Locomotive Inventory as of October 1, 1933

	No. locos.	Average age of groups, years	
		From	To
Strictly modern locomotives:			
2-8-4; 2-10-4; 4-6-4; 4-8-4	1,046	3.6	5.7
Principal active main-line types:			
2-8-2; 2-10-2; 4-6-2; 4-8-2	19,221	8.9	18.8
Articulated	1,619	3.0	23.0
Types generally obsolete:			
2-6-0; 2-8-0; 4-4-0; 4-6-0; 4-8-0; 2-6-2; 4-4-2	19,685	25.9	29.9
Types not classified (12 wheel arrangements)	1,051	...	...
Total road locomotives	42,622		

widely in its details on different individual railways. On some railroads the light character of the traffic may cause less obsolescence of the old, light types of motive power than must generally be charged against them. In any case, however, the advanced age of many of the units in types which average from 25 to 30 years of age is likely to make them expensive to maintain in relation to the amount of service they can render and, in comparison with modern standards, they are likely to be very inefficient operating units.

When serious consideration can again be given to

major capital expenditures by the railways the first interest will undoubtedly be in securing efficient and economical motive power for the main-line services. The use of rail motor cars, probably of light weight and streamlined exteriors, as a substitute for light passenger-train service will still further reduce the usefulness of the old steam locomotives of the lighter type. As the use of light-weight passenger cars increases the possibility for lighter motive power will undoubtedly lead to competition between locomotives of the Diesel-electric type and steam locomotives of medium horsepower designed specifically for high speeds. The Diesel locomotive of sufficient horsepower capacity to match modern steam locomotives for heavy road service is still an unknown quantity. It already has its advocates, however, and will soon be placed on trial to determine how far its operating economy will go to justify its high first cost in comparison with the steam locomotive.

Of the 8,803 steam switching locomotives in the Co-ordinator's inventory, 5,796 are of the 0-6-0 type and 2,821 of the 0-8-0 type. The 0-6-0 type averaged 23.1 years of age, while the larger type average 15.2 years. The former are the locomotives which in most cases are being replaced by Diesel-electric switching locomotives which, during the past few years, have been going into service steadily, even if not in large numbers.

Starting Locomotive Fires in Enginehouses

A study of the locomotive smoke problem indicates that one of the most difficult elements is the elimination of smoke from enginehouses, caused by the building of fires in the locomotives. This was confirmed in the survey which was made at Scranton, Pa., last summer and which was commented upon in the November *Railway Mechanical Engineer,* page 403. Contrary to the firmly fixed belief held by many, it is possible to build such fires with very little smoke; this has been shown conclusively in places where attention has been concentrated upon the problem. The difficulty is that too frequently little or no thought or attention is given to the elimination of smoke in starting such fires.

William G. Christy, smoke abatement engineer of Jersey City, N. J., in a paper on Smoke Abatement Problems, presented recently at the meeting of the Smoke Prevention Association at Buffalo, N. Y., told in a very few words how such fires should be started. In the first place, the operation must not be hurried too much. "The best method," he said, "consists in placing enough coal in the firebox not only to start the fire, but also to take the engine out of the house. This should be placed in the grates with a trough in the middle, in which is placed *dry* wood. With this method never more than No. 1 smoke should be made, and not much of that. Using oily waste, oil torches or oil-soaked shavings is bound to make smoke. One advantage of the dry wood method is that one man can take care of three or four fires."

This process may be a bit slower; it may even, under some circumstances, be somewhat more expensive, but it will remove a serious source of irritation to the people who live in the vicinity, and it will mean so much to the added attractiveness of the community that the railroads can well afford to do the job right. We must not forget that favorable public opinion toward the railroads is an extremely important factor, whether considered from the standpoint of securing traffic under competitive conditions, or from the standpoint of getting a square deal from the legislators and regulating authorities. The railroads need friends and no stone should be left unturned to cultivate the good-will of the public.

How Long Can the Railroads Hibernate?

Certain animals, like the bear, go into retirement on the approach of the winter season, seeking refuge in some cave or den where they, in effect, "live on their fat" until the time comes when they can again make a more satisfactory living otherwise. They must accumulate and store away considerable surplus tissue each year, however, prior to embarking on this annual winter hibernation. Can you imagine a lean, hungry old bear, for example, coming out of his winter quarters all set for some nourishing food and suddenly being compelled to return for another protracted period of paw nursing. For how many years could he stand such a program?

The railroads are in much the same position as the animal mentioned. While not actually hibernating, they have been "living on their fat," in so far as equipment maintenance is concerned, for several years. Locomotive and car repair programs have been greatly curtailed, shops closed, personnel reduced, material stocks depleted, and repair parts taken from stored equipment for use of that which must be kept in service. The extent of under maintenance is indicated by the relatively much greater decline in repair costs than in mileage operated. In 1929, for example, equipment maintenance cost the railroads on an average about 101 million dollars a month, this figure dropping to 53 million dollars a month in 1934, or a reduction of 48 per cent. In this same period principal and helper locomotive miles in freight service dropped from about 55 million to 37 million, or only 33 per cent. Similarly, loaded car miles in freight service dropped from about 1.5 billion miles per month in 1929 to .9 billion in 1934, or only 40 per cent.

For several years, now, locomotive and car miles have been run out much faster than they have been restored by repair programs and this trend cannot continue indefinitely. With few exceptions mechanical department officers are undoubtedly doing everything

within their power to get ready for this increased maintenance program. But without more revenue there is no source from which to secure the means to increase maintenance expenditures. The fact that there has been so little actual decrease in the reliability and safety of railway service after four years of drastic retrenchments is a tribute to the self-reliance and resource of the foremen on whose shoulders has fallen the direct responsibility of keeping cars and locomotives in operation.

A Problem of Equipment Design

The design of rolling equipment adapted to meet railway requirements and develop maximum serviceability presents such an intricate maze of conflicting and oftentimes variable requirements that the designer can hardly be said to be resting on any "bed of roses." Nowhere is this fact better illustrated than in the case of automobile cars. These cars, which are designed to carry a high-class commodity and develop correspondingly high potential earnings, are naturally considered a valuable part of railway equipment. When the automobile industry began to turn out its product in quantities in about 1910, many railroads acquired considerable fleets of automobile cars. Generally speaking, the first cars were 40 ft. long and equipped with 10-ft. doors, which at first comprised two 5-ft. doors on each side. To meet shipper demands for easier loading, this door arrangement was subsequently changed on many cars to one 6-ft. door and one 4-ft. door on each side.

As automobiles became larger and the need for capacity loading was stressed, many railroads designed and built 50-ft. automobile cars with heights well up to the clearance limits and equipped with 12-ft. doors, the latter comprising two 6-ft. doors on each side of the car. The next demand on the railroads, and one which has been particularly urgent in the past few years, has been for the installation of automobile-loading devices which permit loading more automobiles per car, provide a safe and reliable means of holding the load, save labor and material costs for blocking and avoid damage to car floors, the latter proving a very serious item of expense. Since the great majority of automobiles now being shipped are of medium or small size and just as many of these units can be loaded in a 40-ft. car as in a 50-ft. car, the present general demand is for the application of automobile-loading devices in 40-ft. cars. What can the railroad do to satisfy these shippers and yet keep its investment in special-purpose cars within reasonable limits?

The dilemma which confronts many roads in this regard is typified by the experience of a western carrier which handles grain primarily but wants to make a little money moving automobiles into the West. Finding its old 40-ft. automobile cars inadequate and unpopular, this road acquired 300 50-ft. automobile cars about seven years ago, these cars being subsequently equipped with an automobile loading device. These cars carry a higher tariff than 40-ft. cars and are not generally satisfactory to automobile shippers at the present time. Consequently they get few automobile loads. Moreover, they cannot be used for handling grain or even packaged cereals and as a result they have hardly turned a wheel during the past 12 months. The road could probably get a few shipments of automobiles provided it had 40-ft. cars equipped with the loading device. Would it be advisable, however, for the sake of such limited automobile business as may be available, for this road to invest in 40-ft. automobile cars with a loading device and thus add some more highly specialized equipment to its inventory?

Railroads, without exception, are keenly desirous of meeting the full requirements of shippers and providing maximum service. The problem of designing and providing equipment to this end is exceedingly difficult with shipper requirements conflicting and variable while, on the other hand, railway freight classification requirements remain inflexible.

Machine Tool Repairs An Important Factor

When those charged with the responsibility of keeping the equipment of the railroad repair shop up to date consider the problem of machine tool replacement they very often overlook one of the most important factors involved—the cost of machine tool repairs. Studies made during the past few years indicate that what is true with many other types of mechanical equipment is undoubtedly also true in the case of machine tools, namely, that the cost of maintaining them in service increases as the age of the equipment increases. As far as the railroad field is concerned sufficient data have not been kept over a period of years to permit the reduction of this factor of machine tool economics to exact figures but enough is known from the experience of other industries to indicate that railroad shops are paying a rather heavy toll on the upkeep of obsolete shop equipment.

In some instances in the industrial field where plants are equipped with tools none of which exceed from 12 to 15 years in age the expenditure for repairs is as low as 1 or 2 per cent on the investment. Figures indicate that the railroads spend from 3 to 6 times as much as this, probably for no other reason than that the average age of machine tools in railroad shops is greater than in most modern industrial plants.

With an investment in shop machinery and equipment estimated to be about 300 million dollars and an annual expenditure for shop machinery maintenance averaging 24 million dollars for the 10-year period ending with 1930 it would seem that here is a condition of sufficient importance to warrant a thorough study on the part of mechanical officers. Modern tools and equipment offer not only the economies of greater productive capacity but a saving in maintenance expense as well.

Welding Details of Milwaukee Coaches

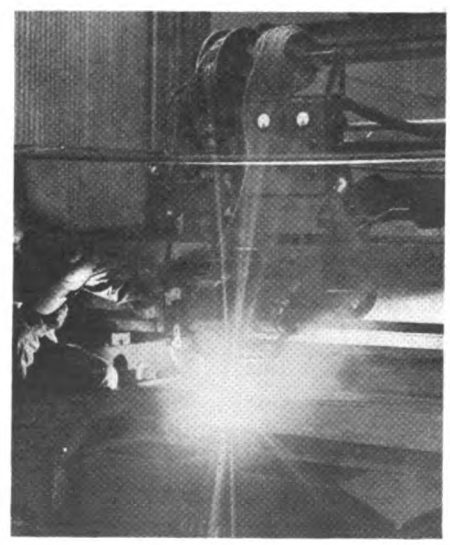
Description of the shop methods employed by C. M. St. P. & P. in construction of lightweight car bodies

A SAVING of approximately one-third was effected in the weight of 52 all-welded steel coaches, built at the Milwaukee (Wis.) shops of the Chicago, Milwaukee, St. Paul & Pacific, as described on page 361 of the October *Railway Mechanical Engineer*. This method of construction and saving in weight, without sacrificing strength, using conventional steel plates and sheets, was made possible by an improved welding process developed by the railroad and utilizing an automatic carbon arc-welding machine especially designed for this job by the Lincoln Electric Company, Cleveland, Ohio. Some of the details of this welding practice not included in the earlier article are described in the present article.

Special equipment used in the welding operations includes, as shown in the accompanying table, one portable automatic carbon arc-welding machine, one portable spot-welding machine, one stationary spot welder, and 11 portable electric welding machines located at various points throughout the shop.

The automatic welding machine comprises a Lincoln Electronic Tornado automatic welding head, Type TA-3, mounted on two parallel cross arms of a carriage which has longitudinal movement over a welding jig arranged to support the individual sheets and parts of the car, side, roof, bottom, etc., in position for welding. The welding head, proper, is guided by a roller on a profile bar which provides for a total up and down movement of 8 in. Cross travel of the welding head, for a total of 14 ft., is obtained by variable-voltage motor drive. The main carriage has a travel of 50 ft. longitudinally, or long enough to cover the entire welding jig. This movement is provided by operation of a hand wheel geared to the carriage wheels which rest on the side rails of the welding jig.

Adequate temperature for welding is obtained by means of an electric arc. The carbon electrode of this arc is maintained, through an ingenious arrangement, at the proper fixed distance above the seam to be welded and revolved slowly to avoid uneven "burn off" of the electrode point. Filler metal is provided by automatic wire feed from a spool on top of the machine, the wire being delivered to a point about ½ in. ahead of the electrode. A paper-covered flux, referred to as a fibrous autogenizer, is also fed automatically to the crater of molten metal, creating a pocket of gas around the weld which prevents the formation of oxides and nitrides in the weld metal. A shielded carbon arc is thus obtained.



Automatic welder in operation

In order to produce uniform welds of superior quality, the Tornado boot is designed to develop a magnetic field around the carbon electrode, and thus steady the arc and avoid what is commonly termed a "wild arc." The resultant weld is not only uniform but free from blow holes, unusually high in tensile strength, ductility and resistance to corrosion. The Tornado boot, which encloses the carbon electrode, is water cooled, and a safety control prevents striking an arc unless the water pressure is on.

A feature developed for this job is the provision of water cooling to localize the heating effects and, when taken in conjunction with the uniformly even bead automatically deposited, provides a smooth external appearance to the car side and roof sheets after welding. The water cooling system consists of an arrangement of perforated pipes located in the welding jig under the steel sheets and designed to throw jets of water upward against the sheets on either side of the weld but without touching it. This method of cooling is sufficiently effective to permit placing the bare hand on the weld within five inches of the arc. Heating of the thin pan sections and warping are thus held to a minimum.

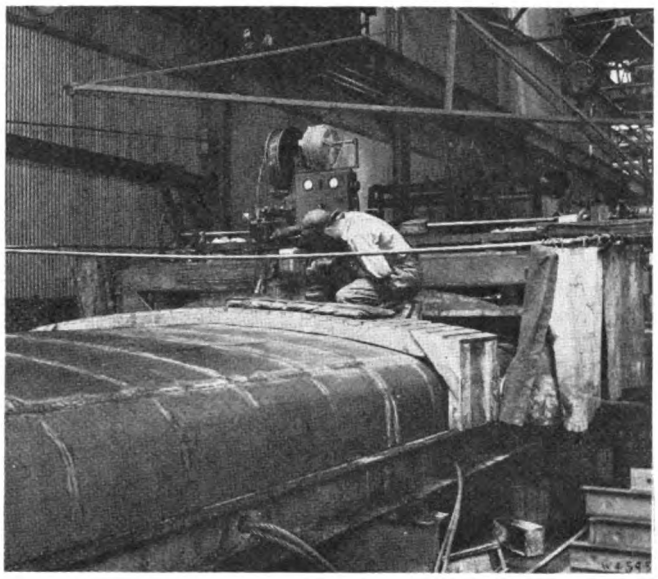
Uncoated $\frac{5}{32}$-in. steel wire, furnished by the Lincoln Electric Company, is used in this welding machine, being carried on the spool above the welding head, as mentioned and shown in one of the illustrations. The paper-covered flux also is carried on another spool, adjacent to the wire spool. All cables, wires and water connections are carried in a flexible 2½ in. Marlin tube suspended by slip rings from a steel cable and light swinging boom as illustrated. This cable is 100 ft. long so as to reach to any part of the shop where automatic welding is required. The entire carriage and welding head

can, therefore, be moved by the shop crane to one welding jig while work is being set up on another.

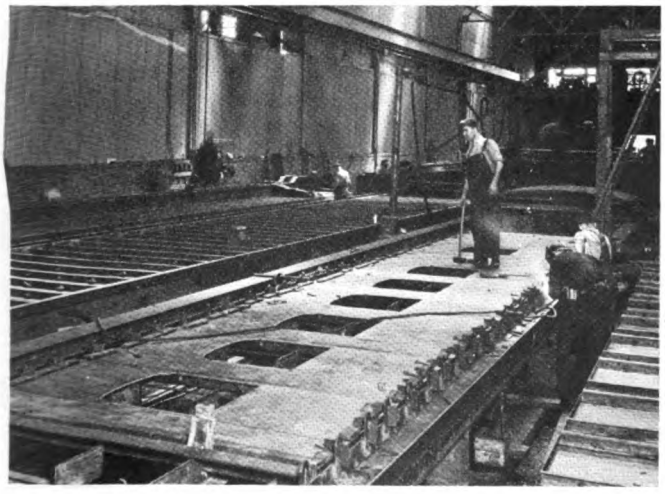
This machine is operated at Milwaukee shops on three shifts, using one operator and one helper per shift. The helper moves the carriage and welding head from seam to seam by means of the hand wheel, cleans and brushes seams in advance of the welding, applies additional flux when needed, and controls the water jets. He also attends to the adjustment of protective curtains which, it will be observed, are suspended from slip rings on pipe provided around the welding head.

Direct electric current for the automatic welder is provided from a conventional electric-welding machine of 400 amps. capacity which takes 440-volt, 60-cycle, 3-phase current from the shop power line and delivers direct current through a flexible lead to a control box on the automatic welder head. This direct current, as delivered to the carbon electrode, can be varied dependant upon the thickness of the metal to be welded and the welding speed.

In operating the automatic machine when welding car sides, necessary switches are thrown in including the a.c. switch in the Lincoln control box. The water switch is also turned on and the welding head adjusted to the proper height which is approximately 1½ in. above the work. The carriage is lined with the seam and the welding head set at the beginning of the seam with the wire approximately ½-in. ahead of the carbon. As a check to make sure that the a-c Tornado boot is on, the magnetic field is tested by bringing a piece of steel close to the Tornado boot. The paper flux is then set so that it touches the carbon, the ground lead fastened to the middle of the fixture, Grade 100 flux painted on the seams, and the carriage lever lowered. The travel, flux and wire feeds, also the arc voltage and current are then set as required. For this work on ⅛-in. side sheet pans, the travel speed is 26 in. per min., the voltage 32 and current 275 amps.



Lincoln Electronic Tornado automatic machine as set up ready for welding a car roof

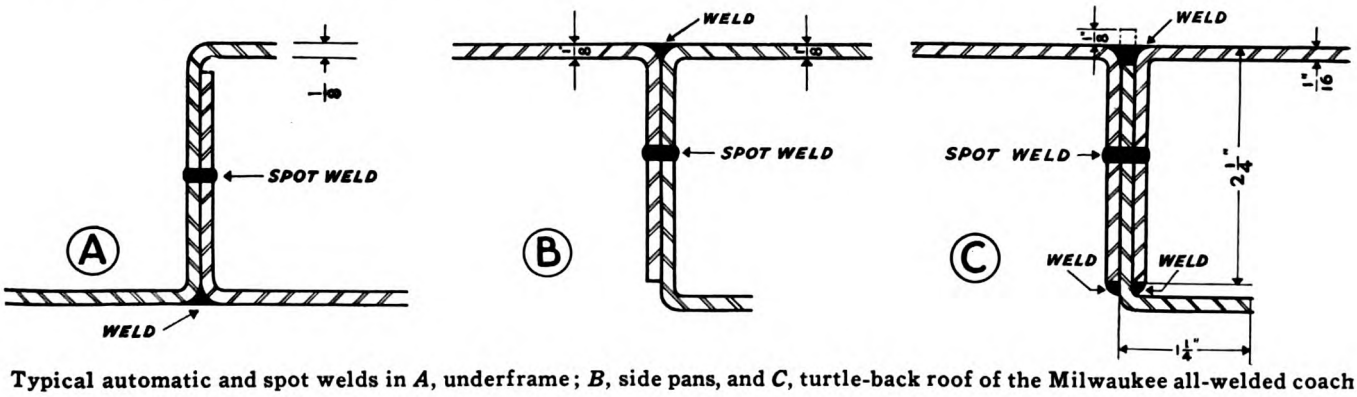


Assembling and tack welding the side pans in a jib preparatory to welding in the automatic welding machine

In welding the car bottom, the carriage beam is again set so that the Tornado boot is approximately 1½ in. above the work, the carriage being lined with the seam and the head set at the beginning of the seam. The same procedure is followed as in the case of the side pans with the exception that the travel is 29 in. per min., the voltage 32 and the current 300 amps. In making the lap weld of the Z-section to the bottom, the entire carriage is brought to the beginning of the seam. On this particular seam, filler metal is not used, the lapping sheet furnishing enough metal to make the weld. The travel speed in this instance is 15 in. per min., the voltage 34 and the current 300 amps.

In welding the roof, the beam is jacked up and pins placed in the top holes, the Tornado boot being properly adjusted above the work. The head is lifted and the roll adjusted to ride on the contour of the roof. The starting block is set so that the carbon is at the beginning of the seam and the wire feeder attachments removed since the center sheet at each seam is set high enough above the roof level to provide necessary filler steel for the weld. The seams are cleaned and painted with Grade 100 flux which is allowed to dry completely before starting to weld. In welding the roof seams, the travel is set for 26 in. per min., the voltage 34 and the current 300 amps.

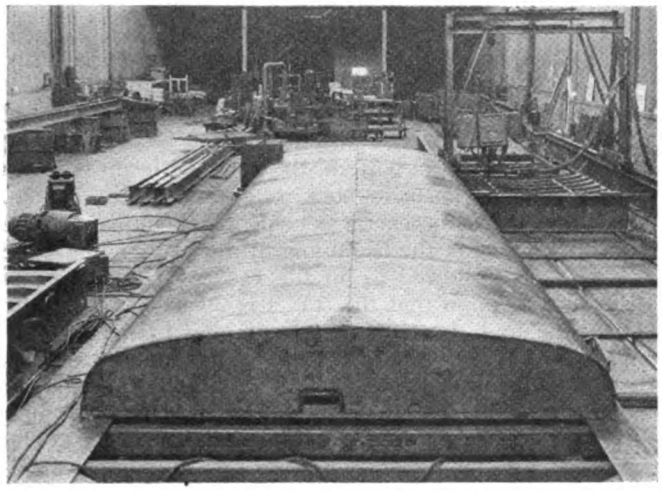
For spot welding the flanges on the car roof, floors



Typical automatic and spot welds in *A*, underframe; *B*, side pans, and *C*, turtle-back roof of the Milwaukee all-welded coach

and sides as shown at A-B-C in the drawing, a Moesta portable-type air-operated spot-welding machine, made by the Tayor-Winfield Corporation, Warren, Ohio, is used. This machine, with an air-operated head and designed for two-man operation, has a capacity to unite two pieces of ⅛-in. steel by spot-welding. The transformer is rated at 133 kva., and a self-contained regulator gives six current steps. A thumb switch on the air gun handle operates the device. The welding timer, furnished by the Electric Control & Mfg. Co., Cleveland, Ohio, gives automatic adjustable timing for the current. A "No-Beat" device prevents the operator from repeating the cycle until the contactor has released from the previous operation.

In using this welder, the gun is placed with the material between the electrodes; the operator presses the thumb switch, causing the air cylinder to exert pressure, after which the operation is automatically controlled. The gun is then moved to the next position and the cycle repeated. Actual current is on the work for about two seconds. An estimate of production of straight-line work, with spots about one inch apart, is 1,800 to



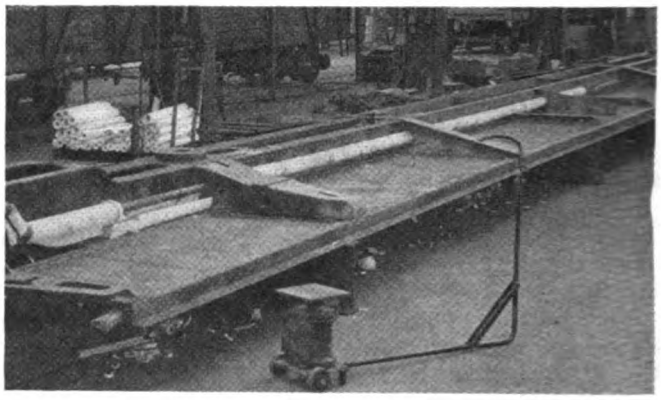
Completed roof—T-W portable electric spot welder shown in right background—G.E. single-unit welder at the left

3,000 linear inches per hour, dependent upon the thickness and shape of the material being welded. The Equipment includes one set of water-cooled cables, one special air-operated head, one remote control contactor, one E. C. & M. timing unit, and one set of points. The machine, about 2 ft. by 3 ft. by 27 in. in size, is supported by chain falls from a light gantry crane which provides ready hand movement of the spot welder to any point desired on the welding jig. This machine operates on 440-volt, 60-cycle, single-phase current.

A stationary spot welder, located near the center of the car shop and used for welding reinforcements in roof-pan section and side-pan sections, consists of a U-30-3 spot welder, also furnished by the Taylor-Winfield Corporation. The capacity of this machine is the same as that of the portable type. The electrodes have an overhang of 30 in., the throat depth of the machine being 33 in. and this is enough to accommodate quite a range of work widths. The transformer used with the machine is rated at 28 kva. An eight-step self-contained regulator is provided. Like the portable spot welder this machine takes 440-volt, 60-cycle, single-phase power.

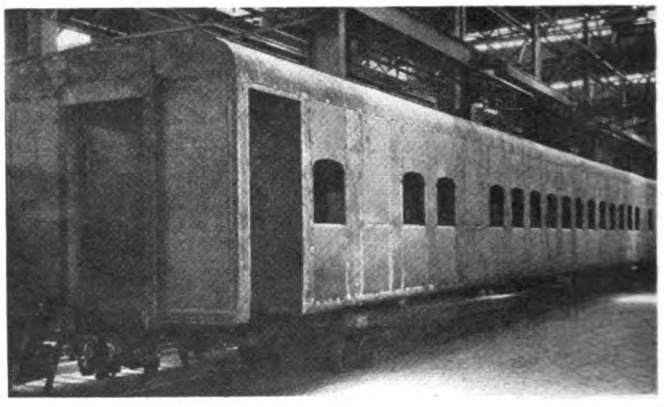
For hand-welding operations, such as spot welding pan sections in the jigs, welding side sections to side sills and many other welds too numerous to mention, a total of 11 portable welding machines are located at various points throughout the shops. In general, these machines will operate on 440-volts, 60-cycles, 3-phase power, taking 200 to 300 amps. Coated wire used in hand welding is of the Sureweld type furnished by the Hollup Corporation, and Airco type furnished by the Air Reduction Sales Company.

The total length of automatic electric welding on the Milwaukee coaches is 1,722 linear ft. per car; continu-



Convenient pneumatic jack used in holding the floor sheet firmly up against the sill and cross-bearers while being welded to them

ous hand arc-welding, 991 ft.; hand-arc skip-welding, 1,444 ft.; and spot welding, 2,378 ft. All welded seams are cleaned and wire brushed with a motor-driven brush to facilitate inspection. Samples of all welding including spot welding are tested and when such samples fail they generally show failures outside of the welds. The welding operators are Milwaukee-trained men who work under one supervisor on each shift.



Car body completely assembled ready for final hand-welding operations

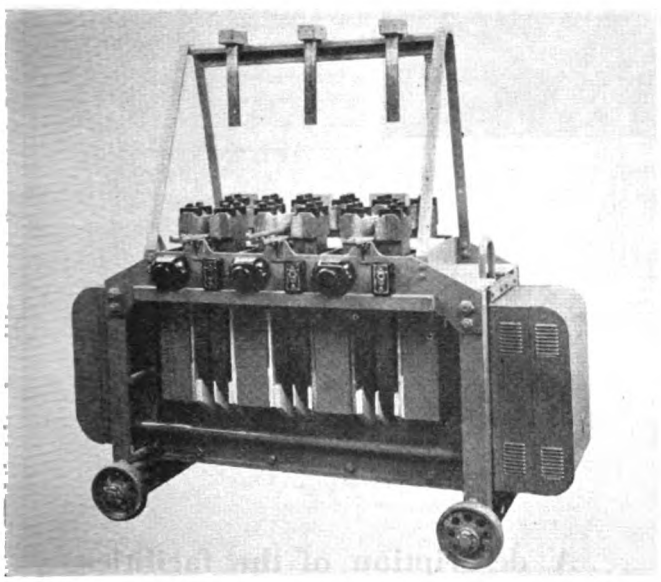
Welding Equipment Used in Fabricating Milwaukee Light-Weight All-Steel Coaches

Number of Machines	Type	Manufacturer
1	Electric Tornado automatic arc-welder	Lincoln Electric Company, Cleveland, Ohio
1	Portable electric spot-welding machine	Taylor-Winfield Corp., Warren, Ohio
1	Stationary electric spot-welding machine	Taylor-Winfield Corp., Warren, Ohio
2	Hanson portable electric welders	Harnischfeger Corp., Milwaukee, Wis.
2	Wilson portable electric welders	Air Reduction Sales Co., New York, N. Y.
1	U.S.L. portable electric welder	Hollup Corp., Chicago, Ill.
2	WD-9 portable electric welders	General Electric Co., Schenectady, N. Y.
1	Portable electric-welding machine	Lincoln Electric Company, Cleveland, Ohio
3	Portable electric-welding machines	General Electric Co., Schenectady, N. Y.

Temperature Control For Electric Heaters

IN the latest designs of the Berwick electric metal heaters manufactured by the American Car & Foundry Company, New York, photocells are used to automatically control the temperature to which the metal is heated.

A photocell is mounted above each of the heating units so that the light from the metal being heated will be projected upon the light-sensitive cell. In operating the heater, a piece of steel is put in the machine and heated to exactly the desired temperature as determined by an optical pyrometer or other suitable means. The photo-electric control unit is then adjusted to control the current supply to the heating electrodes so that the metal will be heated to that temperature. According to tests,



Berwick heaters are now equipped with photocells which automatically control the temperature

the photo-electric unit automatically controls the temperature within a variation of a few degrees.

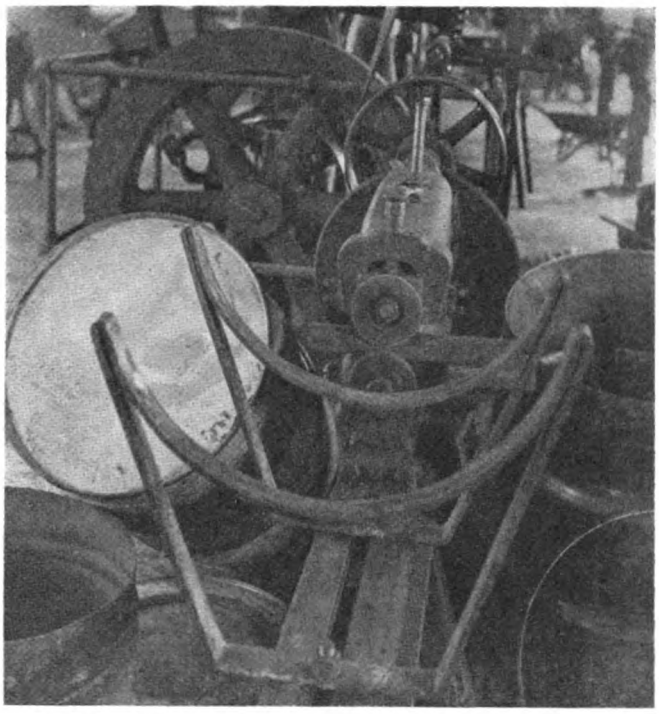
Because the operator is entirely relieved of the necessity of paying attention to the temperature to which the stock is being heated and because of the accuracy of the photocell control, the stock is always heated to the same temperature. Breakage of forging dies because of underheated stock is avoided, and there are no losses from overheated or burned stock.

Another advantage of the electric heating is that less scale is formed, resulting in longer die life and smoother forgings.

Making Oil Drums Into Fire Barrels

By A. Skinner

AT reclamation points where empty oil drums are received from the line, certain of the heavy drums which are in good condition are shipped back to the various oil companies. Other drums, which are made of thin sheets and have been used to ship sticky material



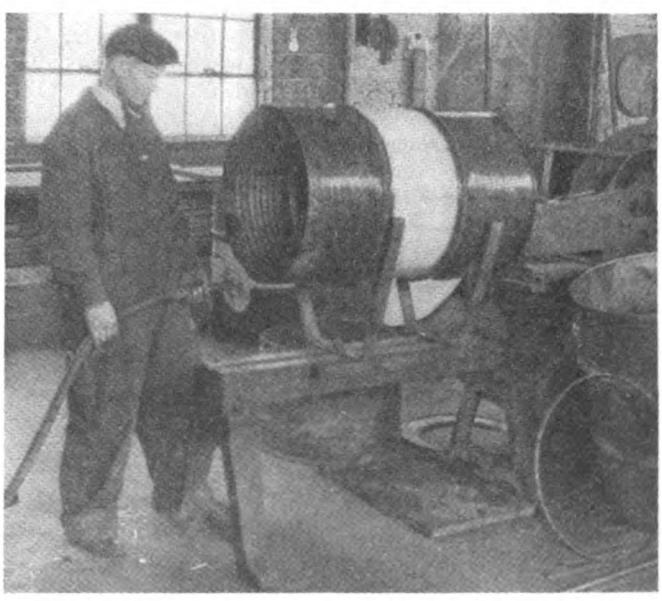
Niagara circular shear as equipped with special brackets to support an oil drum while cutting off the top

like car cement, are cut open, the cement burned out and the metal sold for scrap. Drums of somewhat more substantial construction, which can be satisfactorily cleaned, are taken to the tin shop, the top flanges cut off and the barrels used as water containers for fire protection purposes.

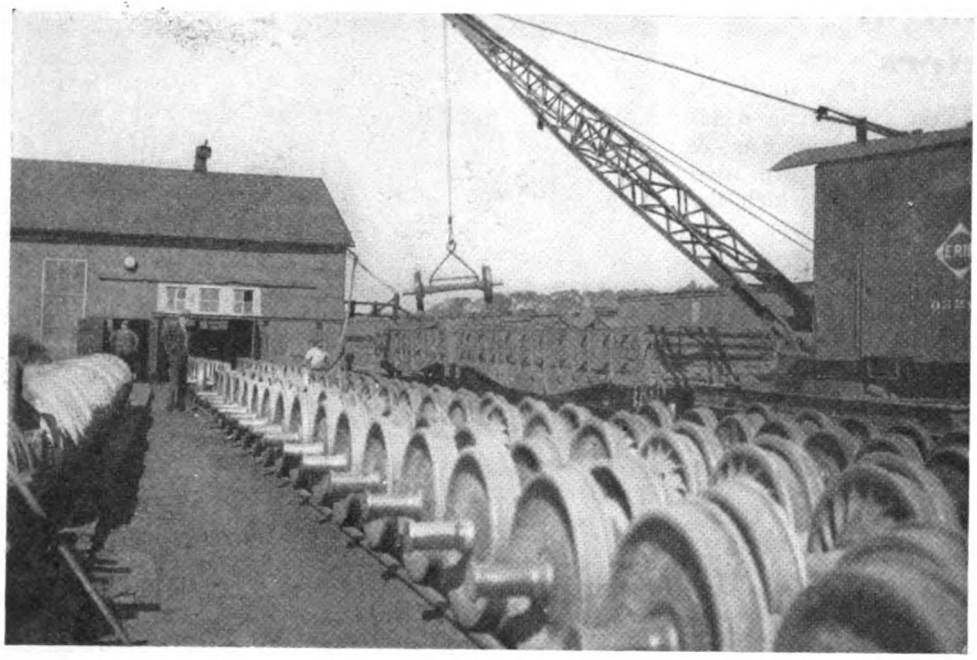
One of the earlier methods of removing the barrel tops was to cut them off with an oxy-acetylene torch, but this leaves a somewhat uneven and jagged edge which may cause injury to the hands of men who are handling the barrels. A better method of reclaiming these oil drums for service as fire barrels is to cut off the tops with a circular shear as shown in the illustrations.

The type of shear used is a Niagara No. 216-B circular shear, equipped with a power-operated circular

(Continued on page 452)



Flexible shaft grinder used to remove any sharp edges or burrs from the barrel top



Wheels are unloaded from the car by means of a locomotive crane and placed on the inbound shop track leading to the demounting press

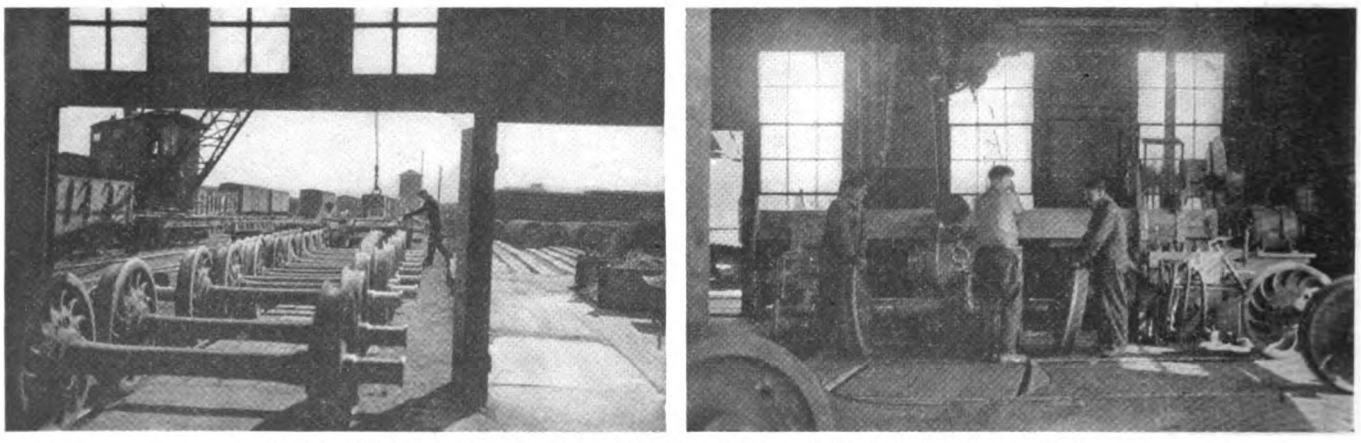
Erie Wheel Shop At Hornell, N. Y.

A description of the facilities and shop methods used for handling an average of 2,500 pairs of new and repaired car wheels a month

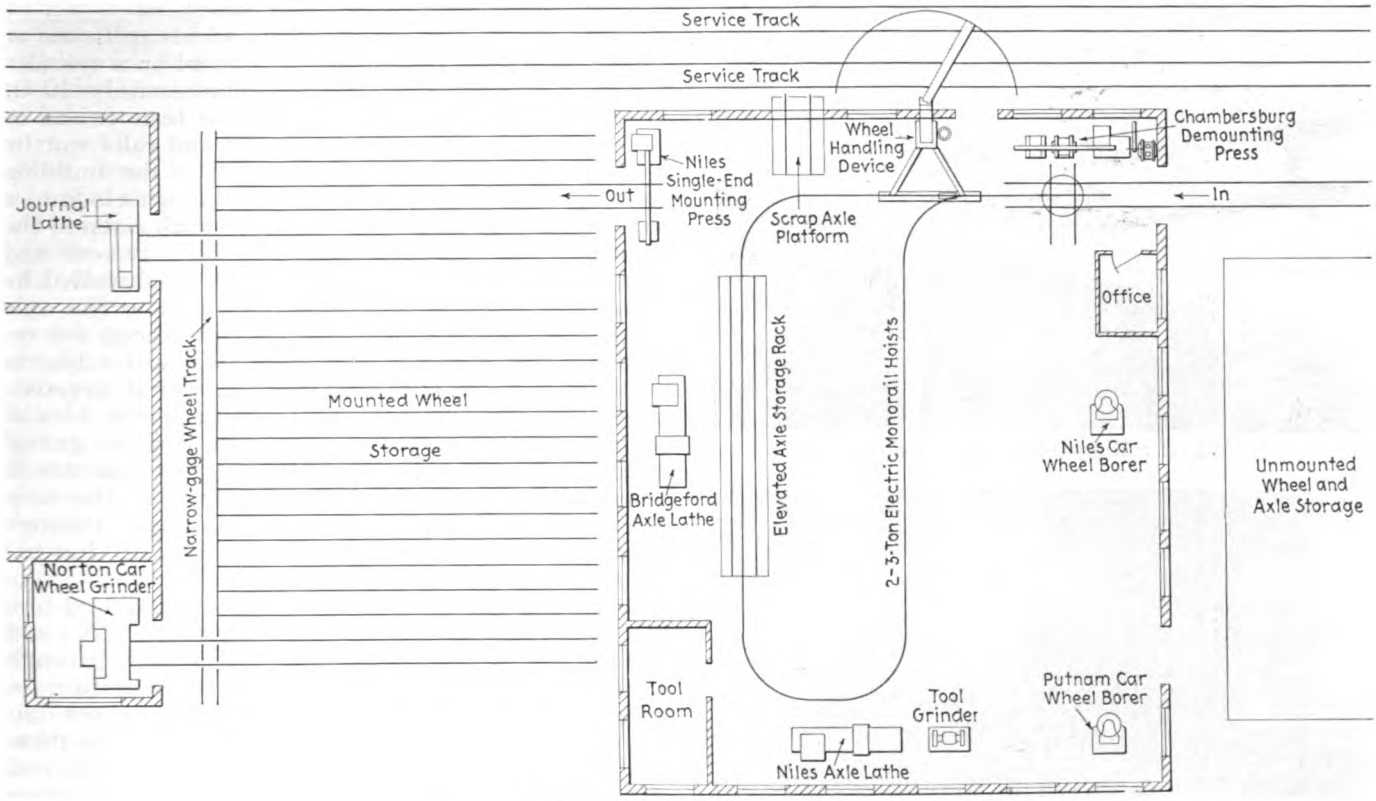
THE major portion of the wheel work for the western district of the Erie is concentrated at the wheel shop located at the car repair yard at Hornell, N. Y. At this point facilities have been installed for the mounting, remounting, boring and grinding of wheels for freight-car use. This wheel shop has an output of approximately 2,500 pairs of wheels a month under present conditions where the shop is working an average of 16 to 20 days a month.

The general arrangement of the wheel-shop is shown in the accompanying drawings and illustrations. The facilities for performing the various operations and handling the wheels through the shop are shown in the table on the opposite page.

The wheels which are shipped to the Hornell shop from various points on the Erie System are received on the yard service track and unloaded by means of a locomotive crane onto the track leading into the shop. The



Left—Wheels enter the shop near the press and (right) are demounted

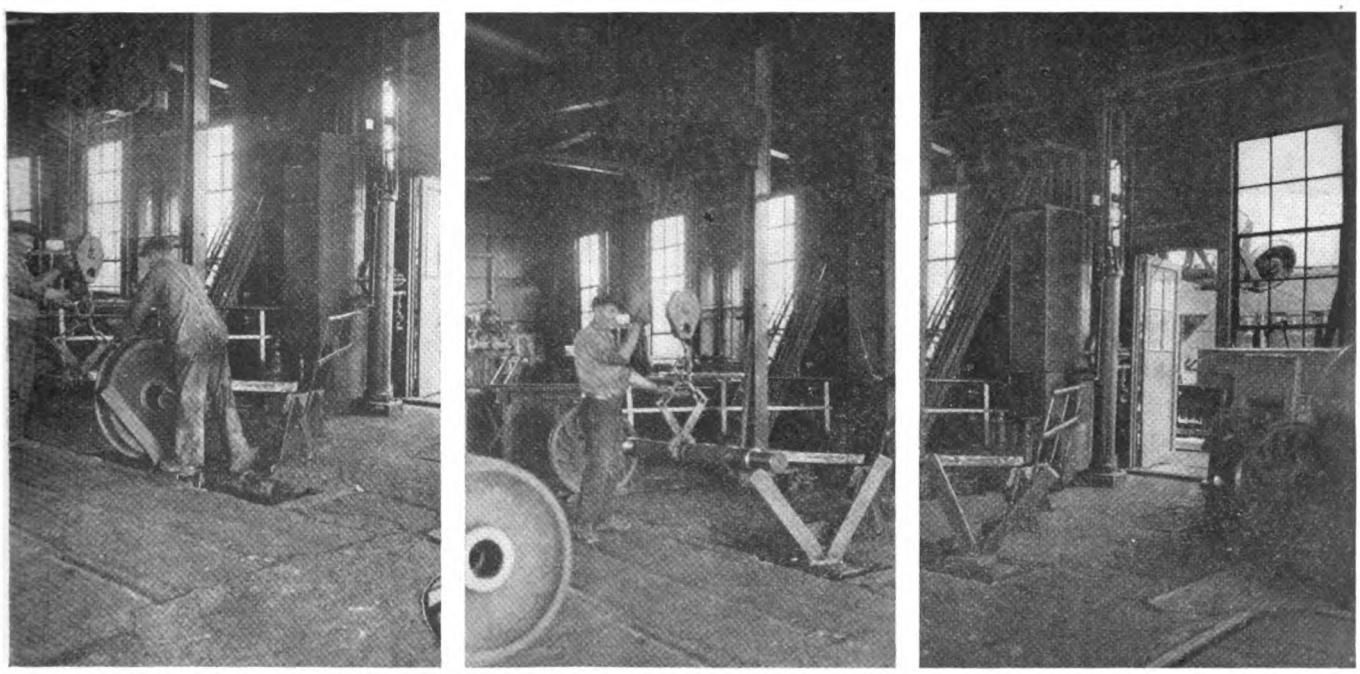


Layout of facilities at the Hornell wheel shop

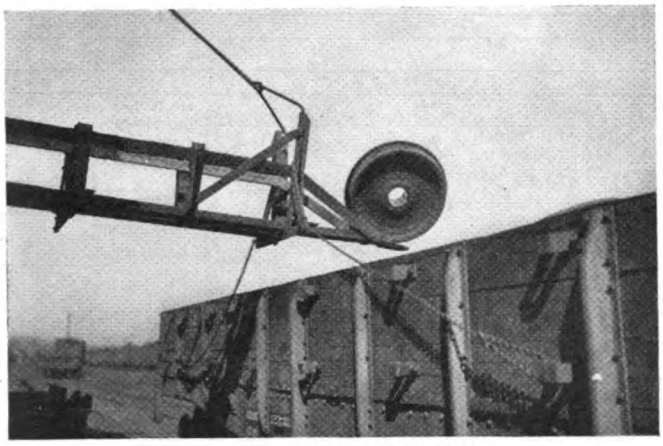
various machines in the shop are so located as to eliminate any unnecessary handling as the wheels pass through the shop in the process of repair. As the wheels enter the shop they are run onto a turntable in front of the Chambersburg demounting press and thence into the machine where protective collars are first slipped over the journals to prevent damage to them as the wheels are pressed off the wheel fit. The demounted wheels, still on the axles, are rolled out of the demounting press and picked up by one of the monorail hoists and moved about 10 ft. to a special wheel-handling device, shown in the illustrations. This device was originally developed at the Erie's Port Jervis Shops to facilitate the handling of wheels destined for the scrap

Shop Facilities at Hornell

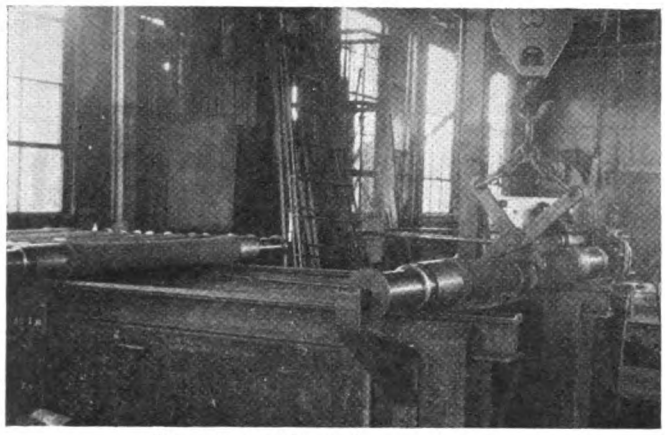
1 Chambersburg demounting press	1 Putnam car-wheel borer
1 Niles single-end mounting press	1 Niles car-wheel borer
1 Bridgeport axle lathe	1 Journal-turning lathe
1 Niles axle lathe	1 Norton car-wheel grinder
1 U. S. floor grinder	2 P. & H. three-ton electric hoists



Scrap wheels removed from the axle are lifted by the elevator and rolled directly in a car



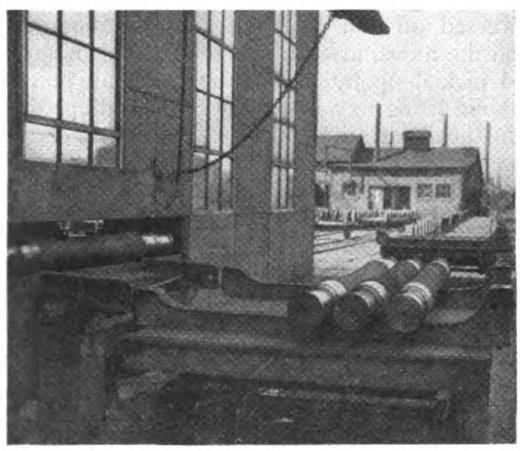
Wheel rolling from chute into car



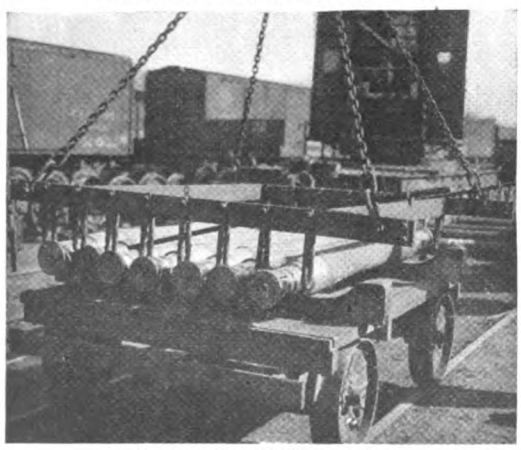
Storage platform for scrap axles

pile. As the illustration shows, it consists of a pair of channeled runways down which the wheels roll, one at a time, into a small elevator which is raised by a cylinder and cable arrangement to a point approximately 10 ft. above the floor. When the elevator has been raised to the proper point the wheel is released and rolls out by gravity through an opening in the side of the building down a swinging chute which dumps the wheels into a scrap car located on the second service track outside the building. After both wheels have been raised and dumped outside in the scrap car the axle is handled by the same hoist to one of two places—either to the axle storage rack in the shop, where they are placed for returning, or on a special rack which is located adjacent to the wheel-handling device for the storage of approximately two dozen scrap axles at a time. Some idea of the value of this wheel-handling device may be gained when it is considered that only about four minutes is consumed in handling a pair of wheels from the time the mounted pair comes into the shop and goes through the demounting press until the scrap wheels are dumped into the car and the axle placed on the rack.

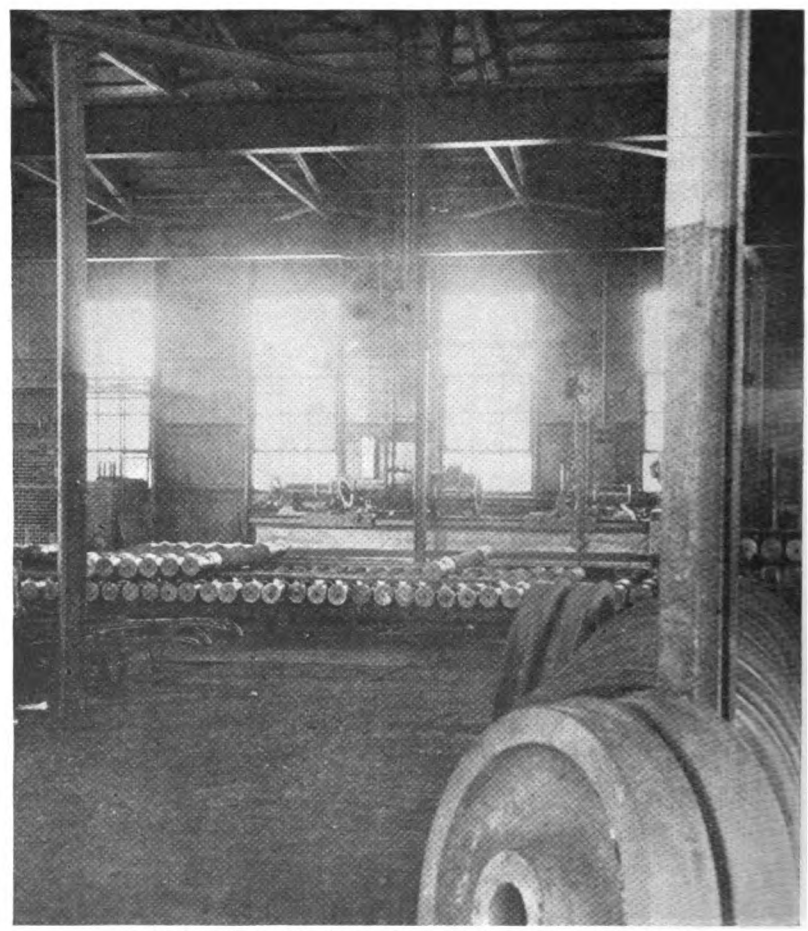
All axle wheel fits and wheel bores are machined to a set of step-size gages in which Kaseberg micrometers and gages are used. The axles, after having gone through the two axle lathes, are marked for identification so that the boring-mill operators are enabled to set micrometer gages to bore wheel fits to accommodate these axle sizes. The unfinished axles are placed at the end of the elevated axle-storage rack opposite the mounting press and the finished axles are placed on the end of the rack nearest the mounting press. New wheels are brought in from the outside wheel storage and placed



Truck for handling scrap axles



Cradle for lifting axles



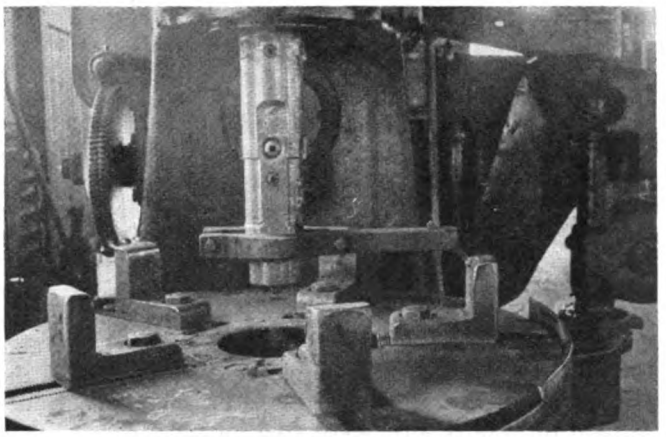
Shop interior showing axle platform and axle lathe

near the boring mill and, after being bored, are stored in the shop at a location near the end of the axle-storage rack on which the finished axles are placed. The operators on the wheel-mounting press take the axles and wheels from these locations and mount them to gage, after which the wheels are rolled out of the shop and either stored in the mounted-wheel-storage space outside the shop or loaded into cars for shipment.

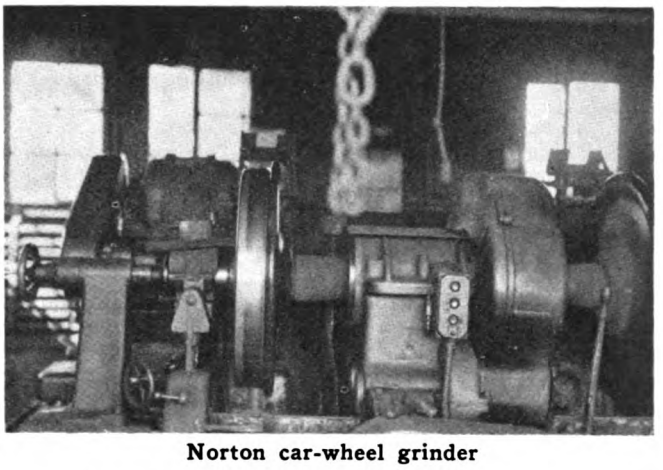
The journal-turning lathe and the Norton car-wheel grinder are located in another building adjacent to the mounted-wheel storage and all mounted wheels requiring either journal turning or tread grinding are placed on storage tracks adjacent to these machines. Wheels are handled transversely across the mounted-wheel-storage tracks on a narrow-gage cross track having a roller-bearing carriage.

Axles which are scheduled to be scrapped are placed inside the shop on the elevated scrap-axle rack previously mentioned and, when a sufficient number has accumulated, a special shop truck, shown in one of the illustrations, is spotted on the track outside the shop adjacent to the end of the axle rack. The axles are rolled out through an opening in the side of the building onto this truck and the truck is moved down the track to a point where the axles can be conveniently handled by the locomotive crane. A special lifting device is used on this crane for picking up seven axles at a time. This device and the method by which it is used are clearly shown in illustrations on this and the opposite page.

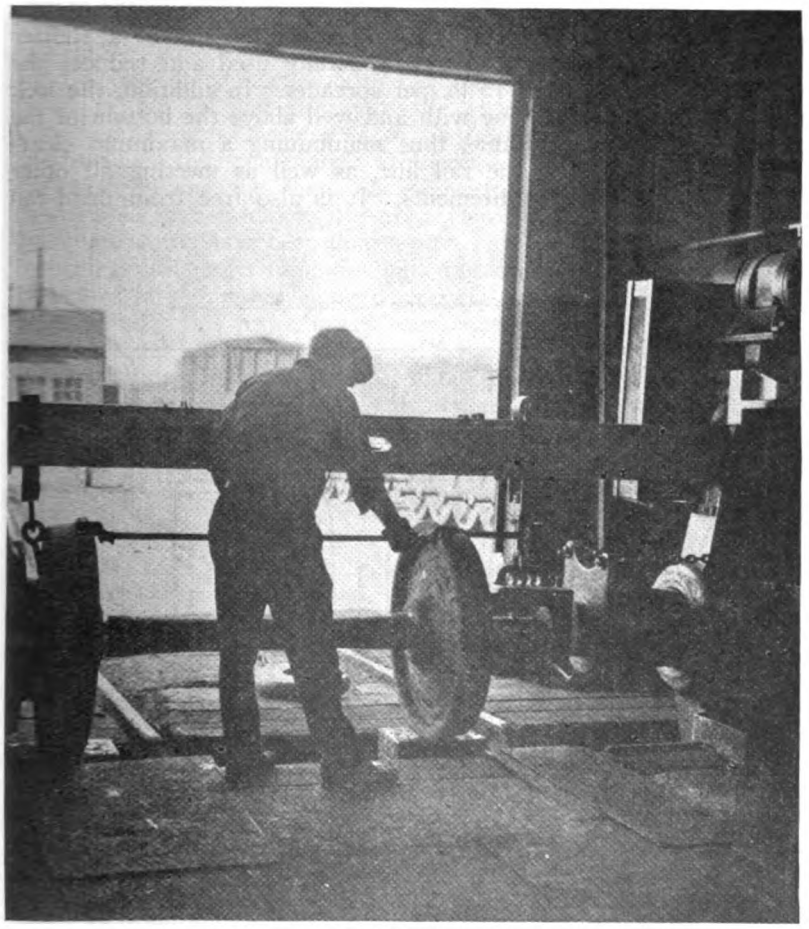
All mounting and mating of rolled steel wheels for this district is done at this shop, but the steel-wheel turning is performed at the locomotive shop, about a mile away from the car shop.



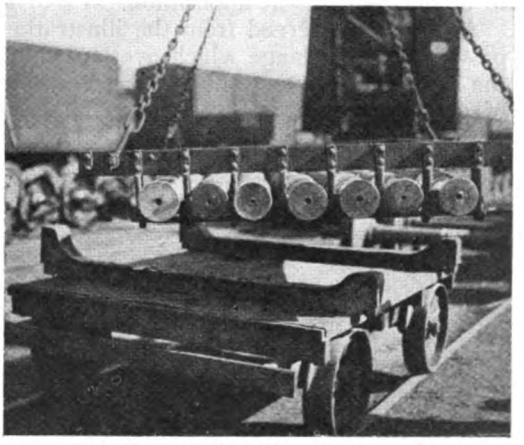
Special tool for truing chuck jaws



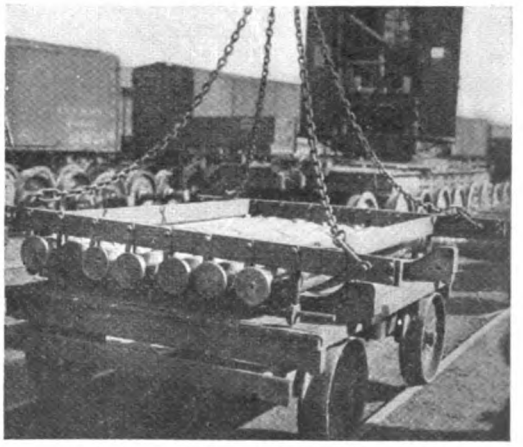
Norton car-wheel grinder



Gaging a pair of wheels while being mounted at the press



Lifting scrap axles from truck



Axle cradle with bar in place

Making Oil Drums Into Fire Barrels

(*Continued from page 447*)

cutter and a pair of half round brackets which support the drum at the proper elevation for cutting. These brackets consist of ½-in. by 2-in. flat iron bent to the shape shown and bolted to the bed of the machine. The drum is simply placed on these brackets and the rotary cutter inserted just inside of the top after the cover has been removed. Operation of the cutter then causes the barrel to revolve in the brackets as the top flange is cut off. A smooth, even edge is left on the end of the barrel but, as an extra precaution, a flexible shaft grinder is used to remove any sharp edge or burr which might cut the hand.

This mechanical method of cutting the ends off oil drums to facilitate using the drums as fire barrels has been found to be quicker, more economical and more generally satisfactory than using a cutting torch.

Malleable-Iron Hopper-Car Door and Frame

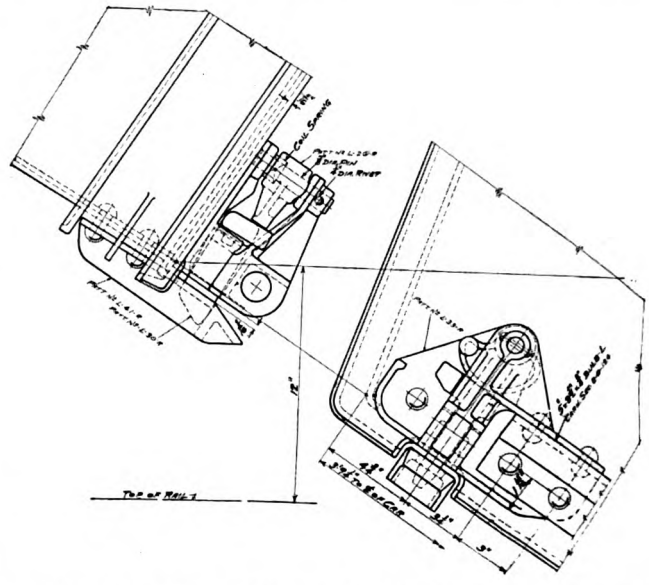
THE Fort Pitt Malleable Iron Company, Pittsburgh, Pa., is offering a malleable-iron hopper frame, door and door lock for railway hopper cars.

The Fort Pitt malleable hopper frame provides a rigid and permanent construction around the entire hopper opening. The frame and door as a unit incorporates hinges and integral door-strap fittings in proper relation to eliminate a mis-fit application.

As will be observed from the illustration, the door is provided with a flange which overlaps the flange around the hopper opening, thus making possible the hauling of pulverized coal and other fine materials reasonably immune from lading loss. The total weight of the unit compares favorably with that of the conventional built-up design. The frame is of four parts: Two sides, one top and one bottom member, riveted together at the foundry to provide a permanent assembly before shipment, thus reducing to a minimum the handling of several parts incident to the built-up design.

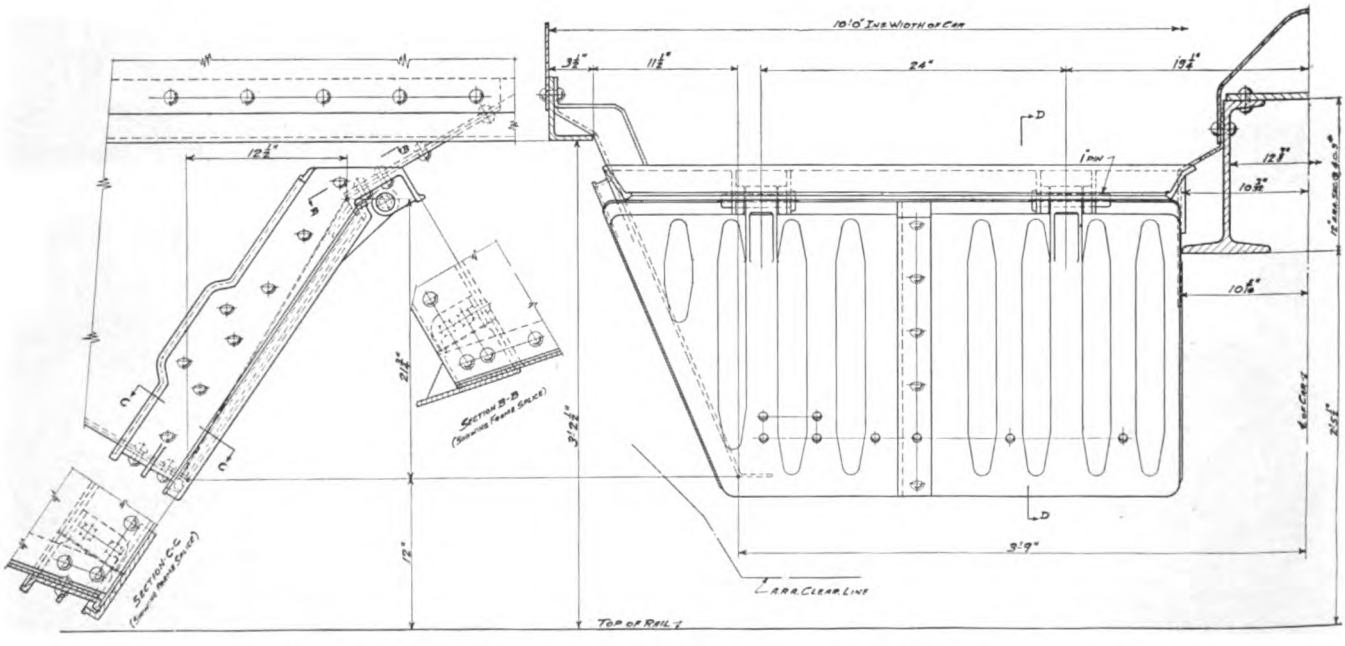
The Fort Pitt malleable positive door lock is designed for safety in operation, strength and simplicity. As a complete unit it consists of only four castings and its total weight is small.

The locking device, being located near the bottom edge of the door in conjunction with the door spreader,



Application of Fort Pitt door lock to hopper car equipped with malleable iron hopper frame and malleable iron door

provides a door stiffener the entire length of the bottom closing edge. This also permits the use of a shorter door spreader than is generally used and reduces the weight about 15 lb. per spreader. In addition, the lock is placed in line with and well above the bottom of the truck side frame, thus maintaining a maximum clearance above the rail line, as well as meeting all other clearance requirements. It is also free from third-rail interference.



Application of Fort Pitt malleable hopper frame and door to a hopper car

The latch assembly is a positive, one-position lock and, when first engaged with the keeper, sufficient clearance between the door and hopper is obtained to allow for any reasonable warpage that may exist in the door. The latch, then driven to its lower position, forces the door home against the hopper opening. The wedge action of the latch holds the door in a tightly closed position, serving also as an automatic take-up for any wear which may develop through use. The latch pawl provides security under all conditions, thus obviating disengagement of the lock due to vibration or otherwise when in rotary dump service.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Method of Repairing Bent Sills on Refrigerator Car—Rule 107

The Central Vermont issued a defect card covering damage to a Fruit Growers Express car. The work done included application of considerable new material, such as sheathing, side door, bunker doors, roof lining, insulation, roof boards, hatchway platform, end ladders, etc., applied in connection with straightening a bent fishbelly center sill and end sill. Bill rendered by Fruit Growers Express amounted to $337.36 and included items which they contended were necessary and involved in straightening the bent sills. The Central Vermont contended that in making repairs a considerable number of items would have been unnecessary had car body been jacked up off underframe and sills then straightened, instead of straightening being performed from inside the car. Under this procedure it was contended repair bill would have been reduced $143.29—the amount in dispute. Fruit Growers Express stated that charges for repairs covered only what was actually necessary in straightening the steel underframe under the most practical and economical method. Method of jacking suggested by Central Vermont was not considered practical and economical as it would be impossible to prevent rods and bolts from turning in attempting to remove nuts and while the nuts might have been split, replacement could not have been accomplished due to corroded threads, consequently it would have been necessary to remove rods and bolts for rethreading or renew them. Method followed and method suggested by Central Vermont were discussed in detail. Bill was received by Central Vermont November 24, 1931, and no exceptions taken until March 31, 1932. Handling was not in accordance with Rule 91 that repair bills must either be passed for payment at once or alleged overcharges brought to attention of company rendering same within 60 days from date bill is received. Repairs enumerated in bill were actually made in accordance with standard shop practice and were absolutely necessary to repair damage that occurred on Central Vermont. In support of contentions reference was made to Arbitration Cases 1060 and 1525. Statement by Central Vermont discussed methods of performing the work and contended that the method followed was not the most economical one.

The decision rendered October 26, 1933, by the Arbitration Committee stated: "The Fruit Growers Express Company followed, in their opinion, the most practical and economical method of making repairs to the damage as covered by defect card of the Central Vermont. There is no prescribed method of procedure specified in the A.R.A. rules to cover the nature of repairs in question, which procedure must be governed by the general design and construction of car. Therefore, the contention of the Central Vermont is not sustained."—*Case No. 1734, Fruit Growers Express Company vs. Central Vermont.*

Wrong Triple Valve Applied—Subsequently Changed by Another Road—Rule 12

The air brakes on a Louisiana & Arkansas car were cleaned by the St. Louis-San Francisco October 12, 1932, and charge for work rendered. The car was delivered to owners October 15, 1932. Air brakes were subsequently cleaned by Missouri Pacific on November 24, 1932 on account inoperative, P2 non-convertible triple valve removed and an A.R.A. standard K2 triple valve applied, charges being rendered accordingly. The St. L.-S. F. refused to acknowledge responsibility for wrong triple valve because car had been on home line between above-mentioned dates, citing Arbitration Decision 1401. Failing to agree, case was submitted for decision. The L. & A. in its statement contended that Rule 12 is intended to protect wrong repairs for a period of 90 days after first receipt of car home. There is no provision that car must not leave home in the meantime; therefore, the St. L.-S. F. is not justified in refusing to issue defect card for wrong triple valve applied. Rule 90 provides that copy of billing repair card of intermediate line standardizing wrong repairs shall perform same function as joint evidence card. There is no record of any wrong repairs having been made to air brakes of this car at home or on any other line between October 12 and November 24, 1932. Arbitration Decision 1401 having been declared obsolete, L. & A. felt justified in claiming protection under Rule 12. The St. L.-S. F. stated that their records showed a K2 triple valve removed and replaced on October 12, car making direct home movement and being delivered to owner October 15, 1932. When brakes were cleaned by M.P. November 24 repair card showed P2 triple valves removed. M.P. repair card was presented to L. & A. in making claim for wrong repairs under Rule 90. Claim was denied on ground that M.P. was not an intermediate line and that their repair card did not perform same function as joint evidence card. Repair card of M.P. is the only evidence owner presented to prove wrong repairs existing. It is contended that a P2 triple valve in place of a K2 valve would have been readily detected in interchange inspection or at some point on owners' rails and that joint evidence should have been furnished in accordance with Rule 12. Since alleged wrong repairs were not corrected before car was delivered home and owner failed to protect with joint evidence, it was contended that claim of L. & A. should be denied.

In decision rendered October 26, 1933, the Arbitration Committee stated: "The contention of the Louisiana & Arkansas is not sustained. Decision 1270 applies."—*Case No. 1735, Louisiana & Arkansas vs. St. L.-S. F.*

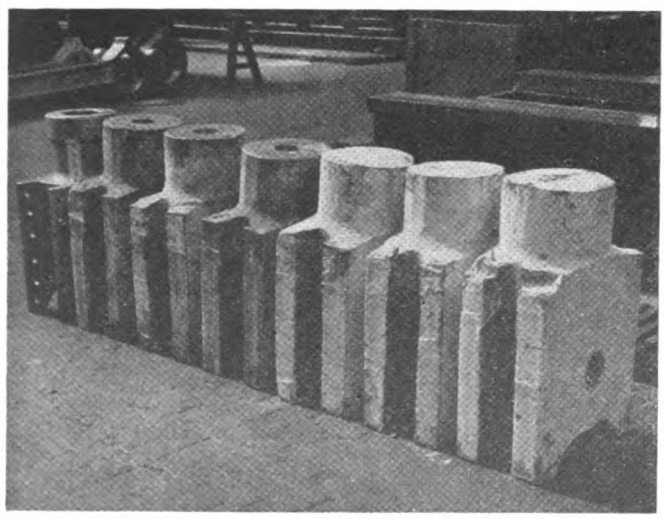
In the Back Shop and Enginehouse

Forged Locomotive Crossheads

DURING the past year or more the Illinois Central has been securing notably good results with an improved type of forged steel crosshead which is now being used on Mikado, Pacific, Mountain and Central type locomotives operated by this road. The new crosshead is slightly heavier than the former cast-steel type, certain sections, previously subject to breakage, having been enlarged. A feature of the design is the provision of large fillets at all corners. In connection with this crosshead, special floating bronze lateral washers are cut into the inside surfaces of the crosshead cheeks to reduce friction and prevent galling of the main rod front-end.

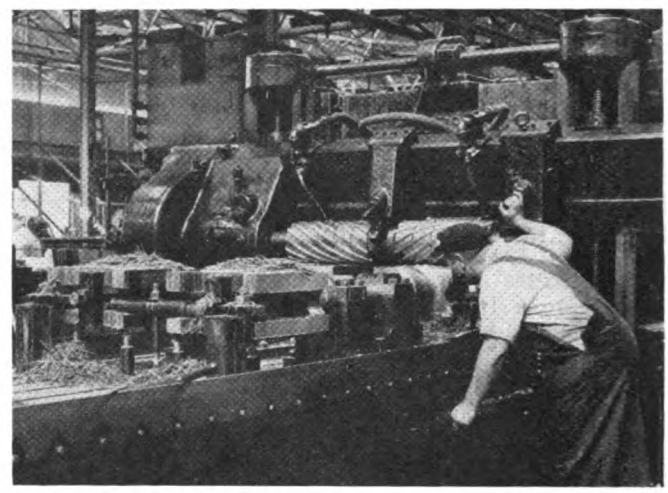
The forged crossheads are made in pairs from steel billets, specification S.A.E. 1040, purchased in two sizes, 10 in. by 18 in. by 37 in. and 10 in. by 16 in. by 40 in. The first operation is to heat billets of the required size to 1,900 to 2,000 deg. F., after which they are forged under a 1,000-ton press to the approximate shape shown at *A* in the operation sketch. The forgings are then re-heated to 1,000 to 1,100 deg. F., placed on an Oxweld automatic shape cutting machine, and the ends cut out as indicated by the dotted line at *B* in the sketch. Each main forging is then cut in the middle on the Oxweld machine, thus producing two crosshead forgings. The forgings are again heated to 1,900 to 2,000 deg. F., the front end placed in dies under the 1,000-ton press and the wings, or cheeks, spread open as shown at *C*.

The next operation is to heat each forging from 1,000 to 1,100 deg. F., place it on the shape-cutting machine and cut the lead hole for the wrist pin fit, also shaping the back end, as indicated at *D*. The forging is then heated to approximately 1,550 deg. F. and allowed to cool slowly for the purpose of normalizing. All scale is removed by sand blasting, thereby providing a forging which is clean and which can be thoroughly inspected preliminary to machining.



Forged locomotive crossheads ready to be machined at the Paducah (Ky.) shops of the Illinois Central

The crosshead is then laid off and carried to an American radial drill press where a 3-in. hole is drilled and subsequently bored for the piston fit. The crosshead ends are faced for length and the front end turned and bored for the piston fit on a Bullard 50-in. boring mill, the taper of the piston fit being ½-in. in 10 in. Outer edges of the crosshead wings are milled, also the insides of the wings milled for the gib fits using an Ingersoll 18-ft. by 56-ft. slab miller. Either four or eight crossheads



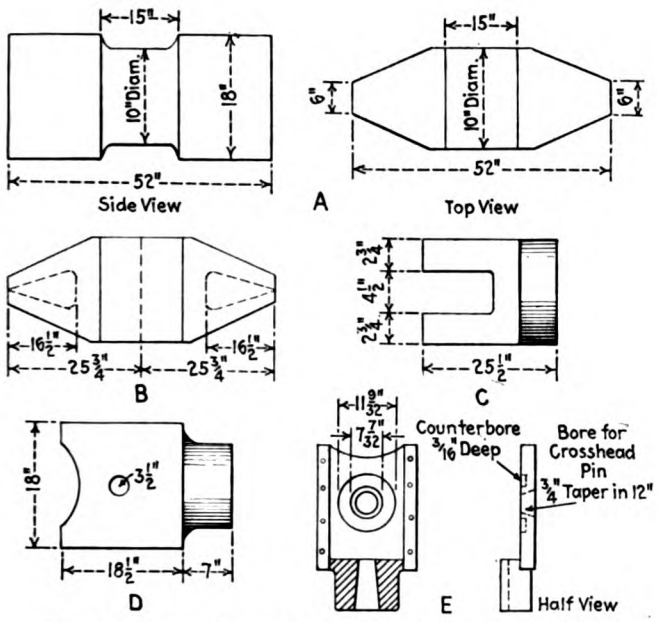
Machining the outer crosshead surfaces, using a special mandrel and V-block set-up on an Ingersoll slab miller

are machined at one time, using mandrels and V-blocks, as shown in one of the illustrations.

The next operation is to continue the machine work on a Gray 10-ft. by 32-ft. planer. The crosshead wings are planed to the proper thickness for the motion plate. If a motion plate tongue is needed, one is planed on both the top and the bottom side of the outside wing, making the crosshead adaptable to either right or left side application. When it is decided on which side any particular crosshead will be used, the extra tongue is planed off. If a motion plate groove is needed, it is planed when the crosshead is assigned to right or left side use. A ¼ in. radius is planed on the inside of the wings for the gib fits. A special mandrel and V-blocks are used to hold the crossheads during the planing operations.

In the next operation the wings are milled to the proper clearance for the front end of the main rod on a Cincinnati No. 5 Milling Machine. The layout work is then completed, the piston-rod keyways being laid out for either right or left, but not drilled until needed.

A Bullard 42-in. boring mill is next used to bore out the wrist pin holes which have a ¾-in. taper in 12-in. and a ⅛-in. step fit. Both wings are counter-bored on the inside to carry the floating brass lateral liner which is 7¼ in. by 11¼ in. by ¼ in. thick. Each line has twelve ¼-in holes, counter-sunk $\frac{3}{32}$-in. deep to serve



Sketches showing various steps in the operation of forging a pair of locomotive crossheads and a general drawing of the crosshead

as grease pockets. This construction is illustrated at *E* in the sketch.

In the next operation, the crosshead is placed in a drill jig and the gib bolt holes drilled and counter-bored on the radial drill press. The dowel pin keyway is drilled, chipped and filed for a ½-in. dowel pin in the wrist pin. The last operation is grinding, filing and polishing a ⅛-inch radius in all sides of the crosshead. All fillets are polished to prevent possible progressive cracks. The average time required to complete a forged locomotive crosshead, made by the method described, is 61.9 man-hours per crosshead.

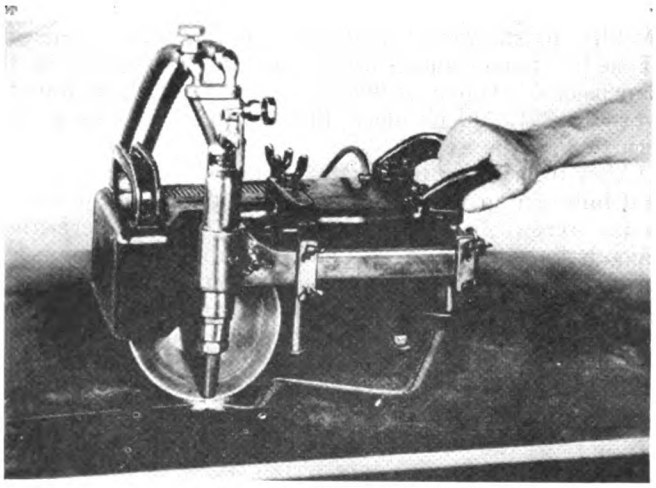
The New Tractograph

THE Airco-DB Tractograph, the latest addition to the Airco-DB line of oxy-acetylene cutting machines manufactured by the Air Reduction Sales Company, New York, is designed to provide a simple means for cutting steel plates and slabs up to 2 in. in thickness accurately into shapes having straight, circular or irregular outlines and extending over practically unlimited areas.

It is a small, compact, motor-propelled unit which can be quickly adjusted to travel at any speed from 2½ in. per min. Its travel is guided by hand along the desired contour laid out directly on the plate or slab. A new drive, combined with other features which enable the operator to change the direction of the machine with exceptional ease, makes it possible to turn sharp corners and follow both simple and intricate contours with accuracy.

The Tractograph will cut beveled as well as perpendicular edges and, with the radius rod in place, will automatically cut arcs or complete circles. Once the operator has set the travel speed, lit the torch and pressed the starting switch, he can confine his attention to guiding the machine. The average mechanic, with a little practice, can follow a line with satisfactory accuracy and, after he has become proficient, can make cuts at much higher speeds than is possible with the hand torch cutting attachments commonly used.

Measuring only 7¼ by 8¼ by 16 in., and weighing but 48 lb., the Tractograph can be easily carried about and used wherever 110 volts, alternating or direct current, are available.

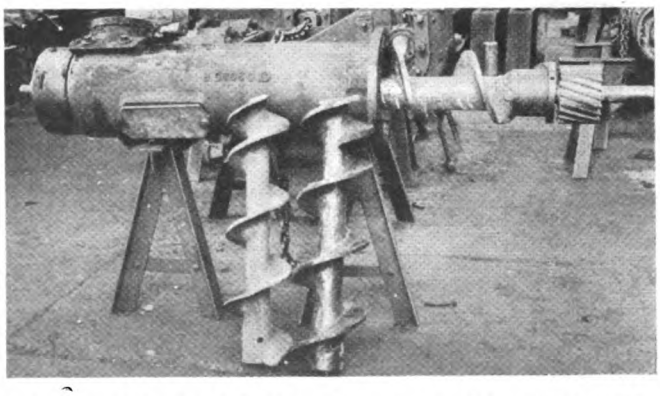


Airco-DB Tractograph in operation

Reclaiming Stoker Screws

IN the reclamation of stoker screws, paddles and clevices, the first operation at the Paducah (Ky.) shops of the Illinois Central is to clean thoroughly all parts by sandblasting. The outside diameter of the flights when worn more than ⅛ in. are trimmed off with the oxyacetylene torch for the application of a ½-in. V-strip, forged from round spring steel or high carbon steel material. Oxidation on the screw flight must be ground off before the application of the strip.

This V-strip is applied by heating, bending and spot-welding, using an oxyacetylene torch. The completion of the welding process is performed by the electric-welding process, using CV electrodes. When the thickness of the flight is 7/16 or less, the flight is built up to standard thickness with CV welding rods, the welded material then being thoroughly cleaned by sandblasting. When the hubs of the flight are worn to 2½ in. or less, they are built up with CV welding rods to 2½ in. outside diameter. They are finished with cast iron welding rods



Stoker screw flights before and after being reclaimed by the electric-welding process

to give a hard exterior wearing surface. The flights are gaged in a lathe and must not be out more than $\frac{1}{16}$ of an in. over or under the standard blue-print dimensions.

When the screw sockets on the conveyor screws are worn to $2\frac{11}{16}$ in. or more, they are thoroughly cleaned by sandblasting, preheated to 600 to 800 deg. F., and built up with CV electrodes, then, after being reheated to 1,500 deg. F., the socket is drifted with a suitable mandrel to standard dimensions. The outside diameter of the hub is built up with CV electrodes to the standard dimensions. When sockets in the paddles are found worn to $2\frac{3}{16}$ in. or more, they must be reclaimed, as just described.

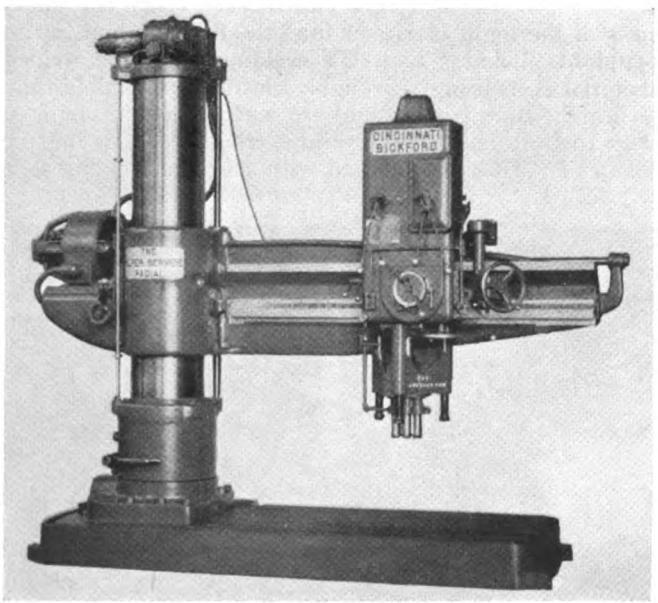
After the welding has been completed, the screw flights and hubs are ground reasonably smooth, the front horizontal screw flights and hubs being ground perfectly smooth for a distance of 4 in. from the ends (points). In all cases, positive polarity is used on the welding machine when cast iron welding rods are being applied, since as much heat as possible is required in welding cast iron by the electric process. All parts reclaimed have the date repaired, make, welder number and operator's initials stamped on the parts.

Multiple-Spindle Drill Heads Used on Radial Drills

MULTIPLE-spindle drill heads for use on radial drills are a recent development of the Cincinnati Bickford Tool Company, Cincinnati, Ohio. A patented self-counterbalancing mounting bracket has been designed which provides rigid support, compensates for the weight of the drill head, and causes its quick return from the work. The multiple head and mounting bracket may be removed in a few minutes, thus quickly converting the machine to a standard single-spindle radial drill.

The illustration shows a 6-ft. Cincinnati Bickford "Super Service" radial drill equipped with a fixed center, ball-bearing drill head to carry three 1¼-in. drills spaced on 2¾-in. centers and each spindle having vertical adjustment. Other drill arrangements may be provided as desired, also provision for supplying cutting lubricant to the drills.

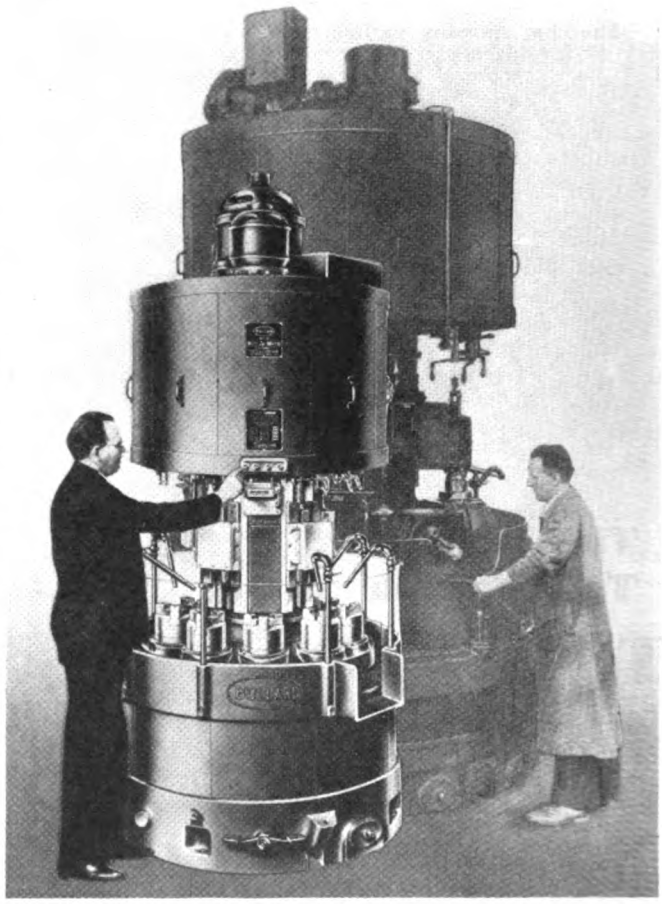
The drill head shown has the spindles in line, but other types of drill heads are equally applicable. Bolt circle drilling of several diameters may be handled on a Super Service radial with an adjustable center distance drill head. The use of a multiple-spindle drill head causes no sacrifice in drilling efficiency or in ease of handling.



Cincinnati Bickford "Super Service" radial drill with multiple-spindle drill head

Small High-Speed Mult-Au-Matics

THE Bullard Company, Bridgeport, Conn., announces a new series of Mult-Au-Matics for the smaller classes of work. These eight-spindle machines are characterized by flexibility, automaticity, and mobility. Series J Mult-Au-Matics are designed for the field of small, high-speed work, and while the two machines, J-7 and J-11, offer all the advantages of the larger machine, they also have many added features. Combined electrical and mechanical functions provide a high degree of flexibility in change-over from one job to another in tool setting and in operation.



Bullard Type J Mult-Au-Matic

Electrification affords three push-button control stations conveniently located for greatest ease and safety of tool setting as well as machine operation. Each control unit has four separate buttons, one for emergency control which stops all functions; a second for starting and

main drive motor; a third for head traverse advance, and a fourth for head traverse return.

Eight spindles allow one station for chucking and seven for work with speeds independently variable to meet the requirements at any station. A wide range of speeds is obtainable. The initial range of the J-7 machine runs in 41 changes from 168 to 1,509 r.p.m. and for J-11 the initial range in 41 changes runs from 84 to 754 r.p.m. In addition, by means of a dual range change feature, it is possible to obtain a blanket 2 to 1 reduction of all spindles. The total maximum stroke is 10 in. The limiting factors of traverse and feed are the minimum traverse stroke of 1⅜ in. and the minimum feed stroke of ¼ in. Control of chuck operation is by means of foot lever conveniently located at the loading station. Rates of feed per revolution range from .004 to .036 in. For work requiring cutting lubricants, a separate easily cleaned unit is obtainable.

Type J eight-spindle Mult-Au-Matics are obtainable in two sizes, known as J-7 and J-11. Their capacities are, respectively, 8 and 12 in. in diameter, with 10 in. for height. The main drive for either machine is 10-hp. motor vertically mounted and direct connected. Traverse motors are, for J-7, 3 hp., and, for J-11, 5 hp. All motors are rated constant speed, 1,760 r.p.m. under full load and may be either a.c. or d.c. to meet plant requirements.

The projected floor space of machines is respectively 50 in. and 58 in. in diameter. The height of both machines from the floor, exclusive of the motors, is only 102 in.

Gages for Wheel Work*

WHEN it is considered that an average railroad operating 100,000 cars and 2,000 locomotives spends about one million dollars a year on wheel work, the importance of proper inspection and gaging becomes evident. It is possible to use some of the present designs of gages in such manner that many wheels are condemned that might remain in service, with safety, a greater length of time.

As an example, consider the gage shown in Fig. 1 used at the present time on most roads for detecting vertical flanges. The accuracy of this gage depends upon the presence of a straight, horizontal portion of the tread, such as is found on a new tire, upon which to place the gage. It so happens that this portion of the tread is no longer straight after the tire has been in service for a month or two. The lack of this straight surface affects the accuracy of the present gage and many wheels condemned for vertical flanges and other defects might be used, with safety, for from one to three months longer. Undoubtedly, the gage used as shown in Fig. 1 is being used properly, but a flange worn as shown in the drawing is impossible without the tread having been worn-hollow. Under such conditions, then, should the gage be dropped down as one would have to do on the worn-hollow portion, it would show a vertical flange long before the flange was actually vertical, assuming, of course, that a flange is not vertical until it is vertical with the bore of the tire; in other words, 90 deg. to the axis of the axle.

The gages shown in Figs. 2 and 3 have been designed by the writer to eliminate some of the shortcomings of the present gages. It is a difficult matter to determine where the wear on the tire is the greatest, whether on the top of the flange as a result of brake-shoe friction; on the outer portion of the tread due to the same cause, or at the center of the tread due to rail wear and shoe friction. How are we to know the actual wear and where it is? Can it be accurately determined with the gages we now have? It is quite possible that one of

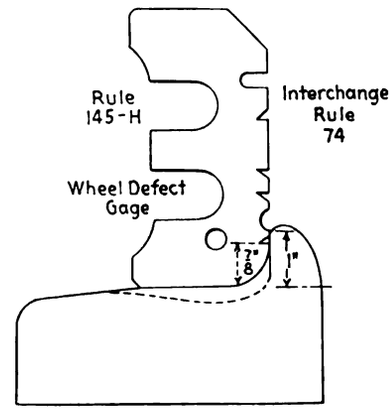


Fig. 1—The A. R. A. gage as used on a vertical flange

the present gages might show an amount of wear insufficient to justify condemning the tire, while at the same time the actual thickness of the tire might be less than it should be. The gage shown in Fig. 2 is used as a test gage to determine wear both of the tire and the brake shoe and has been found to be most reliable because of the fact that it depends upon working from a fixed position, such as the condemning mark on the tire. In using this gage a center mark is placed at the condemning-limit line and another mark above this one at a point on a line drawn radially from the axis of the wheel. The gage is so designed that it uses these two marks as a locator for the gage and, in this manner, the gage is kept square at all times. As may be seen from the drawing, Fig. 2, the wear on the flange,

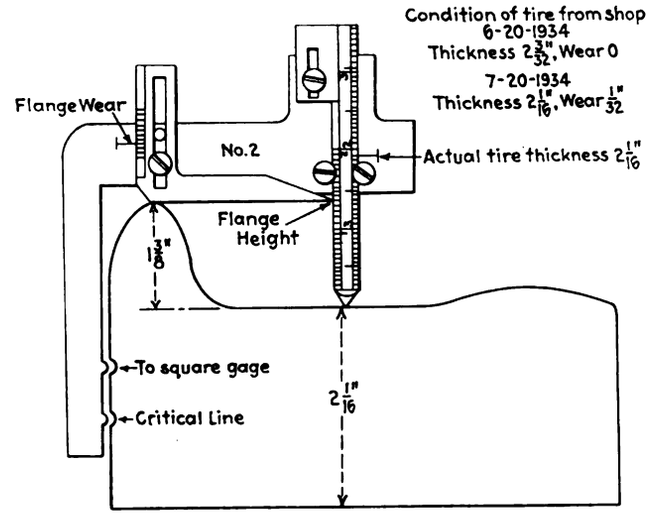


Fig. 2—Test gage used to determine wear of tires and brake shoes

the height of the flange and the actual thickness of the tire may readily and accurately be determined by the use of this gage.

Combination Gage

The gage shown in the drawing, Fig. 3, is one designed for a variety of uses, such as the determination of worn flanges, tread wear, tread thickness, high

* An article submitted by a locomotive inspector who has designed the gages described.

flanges, flat spots, broken flanges, worn collars, broken rims and vertical flanges. It may also be used to check the wear on couplers.

One of the important features of this gage is the fact

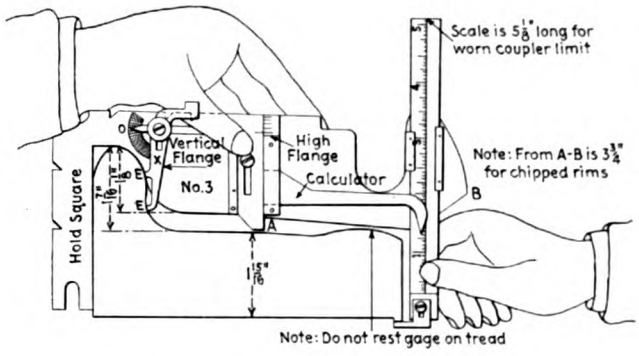


Fig. 3—A gage used for detecting a variety of wheel defects

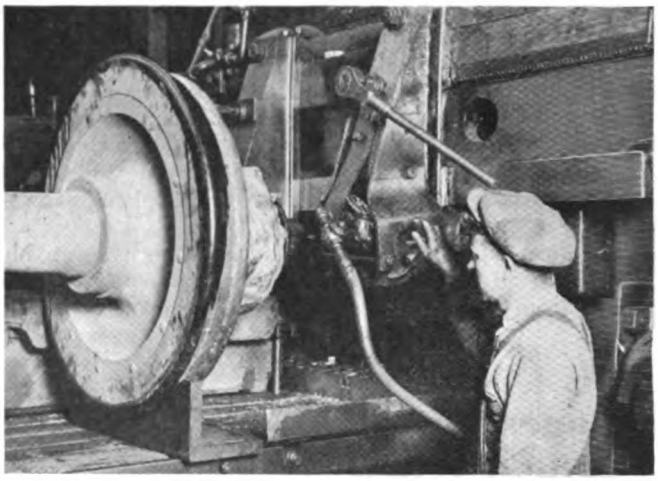
that it works from the inside of the tire as a base and does not foul the outside of the tread; in other words, the gage is free and always in the same position. If the high portion of the tread, such as shown in Fig. 3, were to be removed when gaging with a standard gage one would notice this error immediately.

As an example, consider the case of a locomotive that has been used in a yard with straight tracks and having brake shoes that are worn to the shape of the tread and flange. Say, for example, the thickness is 2 in. Suppose now that this locomotive were transferred to a yard with a considerable number of curves. When the tires are gaged again the usual $\frac{1}{32}$ in. wear and $1\frac{31}{32}$ in. thickness are not found. The false reading is caused by allowing the gage to drop when only surplus metal was worn from the tires on one side of the locomotive owing to the curves forcing the flanges on one side against the rail, while on the other side of the locomotive the wheel was worn only on the outside portion of the tread. The tire on one side of the locomotive, therefore, really has had no actual wear. When the gage is placed on the tread in the usual manner the pointer will be moved up and the amount of wear can be read. It should be remembered that a new tire is tapered to as much as $\frac{5}{16}$ in. on the tread, which overcomes this fault for a few months after turning. Then the gage trouble starts. A high flange can exist under these conditions and not be detected. The combination gage, such as shown in Fig. 3, can be used to show how the tires are wearing and proper remedy can be applied before any great amount of damage is done.

In actual use the combination gage shown in Fig. 3 is placed against the inside of the tire as shown and the calculator arm is pushed down on the tread. As can be seen from the drawing, the gage in this particular instance shows $\frac{5}{16}$ in. wear and the pointer on the scale at the right-hand side of the drawing shows a thickness of $1\frac{5}{16}$ in. without the necessity of any calculations. It should be noted that the scale is adjustable so that it will subtract the thickness of the retaining rim when the tire has one and can be pushed up against the inside of the tire when there is no retaining rim. In measuring vertical flanges the gage is held square and the arm X is moved against the flange until the points EE strike the flange. The pointer will give a reading of the flange, whether or not it is vertical and how much more wear will be necessary before it is vertical.

Keyways in Booster Axles

ON locomotives equipped with tender boosters it is frequently necessary to replace existing crank arms with new cranks and, in the case of one railroad, this required the turning down of the outside end of the axles to a diameter one inch smaller than the original. This, in turn, requires that two new keyways be cut in each end of the axle. Unless special equipment is available for cutting these keyways it presents a somewhat difficult problem which was solved by one machine-shop foreman in the manner shown in the illustration. The mounted wheels were set up on the table of a slab milling machine on a special set of V-blocks. A temporary holder was designed to be mounted on one of the heads



Keyways in tender booster axles are readily cut with this device

on the cross-rail to accommodate an air motor, in the spindle of which an end mill is used. The manner in which this is used is clearly shown in the illustration and the milling cutter is fed by using the table feed on the milling machine. The use of the V-blocks on the table for holding the wheels assures the keyways being parallel with the center line of the axle.

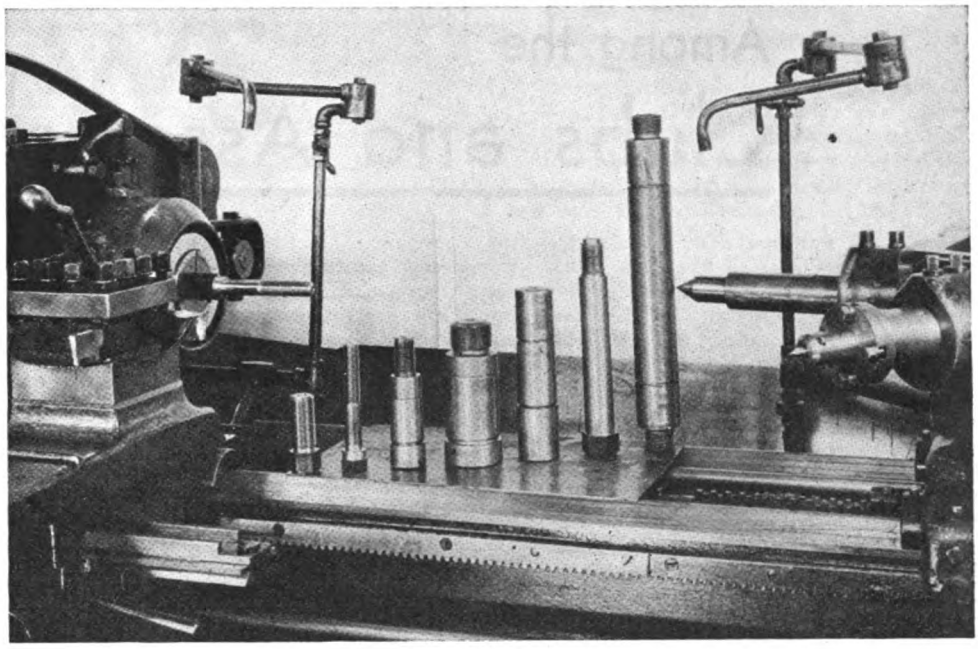
Making Standard Pins and Bushings

By R. E. Hug*

IN recent years, as railway budgets for new shop equipment have been reduced, the problem of machine-tool replacement has become increasingly difficult. In cases where funds are available for the provision of new tools, there is also the question of whether they should be replaced in kind or by some more specialized tools which are capable of higher production and, at the same time, are sufficiently versatile so that they can be kept busy when not used on production work.

For example, locomotive pins and bushings have in the past and, to a certain extent, still are being made on engine lathes. By this method, the pins and bushings are made up for the different parts as needed, and it is necessary to arrange this work in line with the case-

* Production Supervisor, Chicago, Rock Island & Pacific, Silvis, Ill.



Typical standard pins and bolts manufactured in quantities at Silvis Shop. A description of these parts together with dimensions is given in Table I

hardening program. That is, if the casehardening is done at night, it becomes quite a task to have the entire set of pins and bushings ready for one locomotive at a given time. In cases where some parts are not completed, the entire set is delayed another day. The question arises as to how such conditions can be relieved.

The first step in solving this problem at the Silvis (Ill.) shops of the Chicago, Rock Island & Pacific, was to replace a worn-out and obsolete turret lathe with a Warner & Swasey 1A, 2½-in. machine with bar feed and taper attachments. This provided the equipment necessary to turn out the pins and bushings in quantities.

The second step was to eliminate, as far as possible, the old method of making pins and bushings as needed, and incorporate the standardization plan. This was accomplished by selecting a pin which was frequently used and, instead of making only one or two at a time, making them in lots of 50 to 100. The majority of these motion pins have two taper fits, one on each end, and as the parts in which they are used have to be reamed at certain intervals, it is necessary to make step sizes. A set of three gages are used for each pin, the first being for the nominal size of the pin, the second for 1/32 in. oversize and the third for 1/16 in. oversize. These sizes refer to the large diameter of the taper; however, the body size also is made in step sizes to accommodate the increase of the large diameter of the small taper end. The body sizes of all these pins are made .010 in. oversize to allow for grinding and, following the casehardening process, they are ground to size and stored. After a successful demonstration, this standardization plan was extended until 35 different sizes were included covering 92 sizes.

The third step was to standardize the machining of the bushings. These are also made on the turret lathe in large lots from full lengths of steel tubing, while the old method of doing them on a lathe restricted the quantity to one or two at a time. The bushings are bored, reamed and cut off, and stored until they are turned on the outside to fit the particular part in which they are used. It is necessary to provide bushings with corresponding sizes of the pins. After the bushings are casehardened, they are pressed in their respective parts and are then ground to a gage which corresponds with the pin.

With this standardization plan, it is not a burdensome job to prepare a set of motion-work pins and bushings, as the majority of the parts are on hand and can be gathered together quickly. As the locomotive returns to the shop for repairs, the worn pins and bushings are removed and replaced with new. If, however, the parts require reaming, the next size pin is used. The major economy is not in the labor saving made by the quick replacement of parts, but more in the labor saved in making the parts on a systematic basis. It is not unusual to have increases in production as high as 300 per cent.

The turret lathe and several samples of the standard pins and bolts are shown in the illustrations. It will be noted that the first two pieces, shown at the left in one of the views, are not motion-work pins, but are items added to the regular work of this machine to keep it busy. After the plan was in operation for a short period, it was discovered that the machine could be used to make other items in addition to performing the work of two obsolete turret lathes and the major part of the work of two engine lathes.

The operations described are significant because they show that, under present conditions, it is more than ever essential to take advantage of every opportunity to standardize the detail parts of locomotives and produce them in quantities on modern machines at minimum unit cost.

Table 1—Description and Dimensions of Parts Shown in the Illustration

Piece No.	Name	Stock	Length, in.	Diameter, in.	Taper	No. of Operations	Min. Each
1	Side rod keeper bolt	1¼ in. hex.	4	1⅛	None	6	6.5
2	Motor car cap screw	1⅛ in. hex.	5¾	⅞	None	6	11.0
3	Reach rod pin	2 in. rod	6	1¾	2	14	14.5
4	Eccentric rod pin	2¾ in. rod	6¾	2⅝	2	14	20.0
5	Valve rod crosshead pin	2 in. rod	8¾	1⅞	1	11	13.5
6	Link cheek taper bolt	1⅝ in. hex.	9¼	1¼	1	5	10.5
7	Link hanger pin	2¾ in. rod	15¾	2	None	12	18.0

Among the Clubs and Associations

NEW YORK RAILROAD CLUB.—The sixty-second annual dinner of the New York Railroad Club will be held at the Commodore Hotel, New York, on Thursday, December 13. A reception will be held, at 6:15 p.m., preceding the dinner at 7.

NEW ENGLAND RAILROAD CLUB.—"Three Mechanical Problems for Solution" is the title of a paper to be presented by W. G. Knight, mechanical superintendent, Bangor & Aroostook, before the meeting of the New England Railroad Club on December 11 at the Copley-Plaza Hotel, Boston, Mass. Dinner will precede the presentation of this paper at 6:30 p.m.

CENTRAL RAILWAY CLUB OF BUFFALO.—Railroad Terminal Operation will be the subject for discussion at the December 12 meeting of the Central Railway Club of Buffalo to be held at 8 p. m. at the Statler Hotel, Buffalo, N. Y. C. R. Wiseman, general yardmaster, New York Central, will speak on The Yardmaster's Viewpoint; W. H. Sitterly, assistant chief car inspector, Pennsylvania, on The Car Man's Part of the Job; P. C. Berkwater, agent, Erie, The Agent's Side of the Story; M. A. Quinn, master mechanic, Delaware, Lackawanna & Western, The Motive Power Department's Assistance Necessary, and William J. Sheridan, assistant general freight agent, Baltimore & Ohio, on The Traffic Man. Officers for 1935 will be elected.

ASSOCIATION OF AMERICAN RAILROADS.—Further progress in the organization of the new Association of American Railroads was taken when the board of directors met in Washington on October 31 and elected additional officers, although three vice-presidents are still to be elected. The executive committee also held a meeting but made no announcements. J. J. Pelley, president of the association, has taken up his headquarters at Washington. ¶ M. J. Gormley, since April 1, 1933, president of the American Railway Association, was elected executive assistant to the president; James R. Downes, assistant vice-president of the Pennsylvania, was elected vice-president in charge of operations and maintenance; Harold J. Forster, secretary and treasurer of the American Railway Association, was elected secretary and treasurer of the new association, and Stanley J. Strong, secretary and treasurer of the Association of Railway Executives, was elected assistant secretary and treasurer. Fairman R. Dick, a member of the investment firm of Dick & Merle-Smith, of New York, was appointed advisor on finance and credit. The vice-presidents yet to be named are for the traffic, finance, and planning and research departments. ¶ The department of operations and maintenance is to deal with all matters pertaining to operating, car service, transportation, equipment, telephone and telegraph, signaling, maintenance and construction engineering, mechanical, purchases and stores,



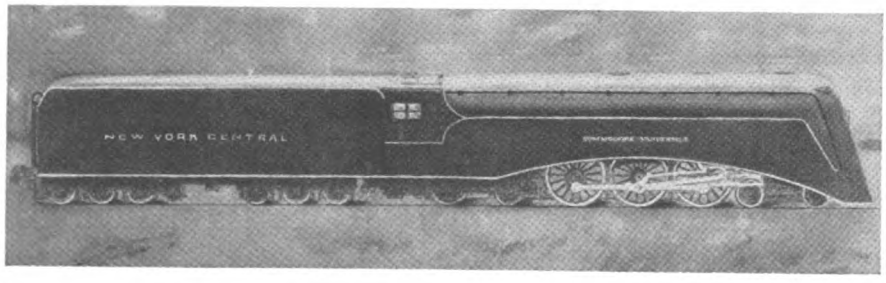
James R. Downes

inspection, freight claims, and such other matters of a related nature as may require attention or referred to it by the president.

CAR FOREMAN'S ASSN. OF CHICAGO.—J. A. Deppe, assistant superintendent car department, Chicago, Milwaukee, St. Paul & Pacific, will present a paper on the Preparation of Freight Cars in Terminal Yards for Road Haul before the meeting of the Car Foreman's Association of Chicago to be held at 8 p. m. on December 10 at the LaSalle Hotel, Chicago. ¶ At its meeting on Monday evening, November 12, the Chicago Car Foreman's Association introduced the innovation of devoting its entire meeting to a discussion of questions bearing on the work of car-department supervisors and inspectors. Among the subjects discussed were rusty journals—stored cars; shopping loaded cars on account of worn brake attachments; dust guards; application of split keys, cotter keys, etc.; elimination of running defects; journal bearings—loaded cars—packing "in date"; packing—exchange of wheels—unit frame; side carding cars—pivoted machinery; inspection pits. In discussing these subjects and questions the members expressed their opinions freely and obtained a much clearer understanding of many of the controversial questions raised.

WESTERN RAILWAY CLUB.—Meeting held Monday evening, November 19, at Hotel Sherman, Chicago. Subject "The Freight Car" by V. R. Hawthorne, secretary, Association of American Railroads, Mechanical Division. ¶ Regarding certain recent suggestions for the freight car of the future, particularly as regards weight, Mr. Hawthorne said that developments already made in light-weight materials will permit a load-carrying ratio of five to one in cars of otherwise conventional design. Regarding small cars of special design, Mr. Hawthorne pointed out their limitations and particularly the fact that while present small-lot shipments would seem to favor the use of relatively small cars, the ratio of deadweight to load-carrying capacity is high in this type of car and, moreover, since freight equipment has an effective service life of two decades or more cars must be designed for average needs during this extended period and not solely for the needs of the moment. ¶ Mr. Hawthorne explained that, while shippers doubtless prefer numerous door openings for greater ease of loading and unloading, from the point of view of equipment design and maintenance, door openings should be restricted in number to those absolutely needed. ¶ In connection with the all-purpose car Mr. Hawthorne stated that, while this type of equipment may be desirable from the point of view of utilization and to reduce empty car mileage, this advantage is largely theoretical and that, in reality, a car designed to handle all kinds of commodities would be unsatisfactory for the shipment of any one. Mr. Hawthorne concluded his paper with the statement that freight containers and container cars may prove to be the best means of meeting small sales unit shipping requirements, provided designs can be worked out which are practicable and will fit into the complete scheme of transportation service which railroads are now endeavoring to provide.

* * *



The New York Central's Streamlined Locomotive

It is believed that the streamlining of this Hudson, whenever the locomotive is operated at speeds of 70 to 90 m.p.h. or more, will effect a decrease in head air resistance of 35 to 36 per cent, which is expected to be reflected in a saving in fuel. Several other beneficial features are also claimed for the new design. It provides additional insulation for the cylinders, auxiliary apparatus and pipes, thus helping to protect them from freezing temperatures. The 79-in. drivers are also equipped with roller bearings.

NEWS

Diesel Engineering Handbook—A Correction

In the review of the Diesel Engineering Handbook given on page 404 of the November issue of the *Railway Mechanical Engineer* the number of pages in the book was incorrectly stated as 32. The book contains 320 pages.

Mechanical Division Letter Ballot Results

The recommendations of various committees presented at the meeting of the Association of American Railroads, Mechanical Division, held in Chicago, June 27, 1934, were submitted to letter ballot, the detailed results of which have just been made available in Circular DV-821. The committee recommendations, totaling 93 in number, were all acted upon favorably. Proposed amendments to the Standard and Recommended Practice of the Division were approved effective March 1, 1935, and amendments to the Interchange Rules and Loading Rules of the Division were approved effective January 1, 1935.

AB Brake Mandatory After 1944

The Board of Directors of the Association of American Railroads on November 16 adopted the recommendations of the General Committee, Mechanical Division, to provide that on and after January 1, 1945, all freight cars in interchange must be equipped with the AB brake. This action follows the adoption, by a vote of more than 80 per cent of the letter ballots cast, of the proposition to modify section (a), paragraph 4, Interchange Rule 3, to require that all cars in interchange service on and after January 1, 1945, must be equipped with brakes meeting the requirements of the A.R.A. specifications for air brakes adopted in 1933. Quarterly reports, showing the number of freight cars acquired and the number of freight cars on which brake equipments have been converted each month, are to be made by the railroads to the association.

Export of Locomotives and Cars for Chile

The largest export shipment of railroad equipment since the beginning of the depression was made by the Baldwin Locomotive Works and the Bethlehem Steel Export Corporation at the Baldwin docks near Chester, Pa., on November 16. The shipment consisted of 10 locomotives, 10 tenders and 15 first-class passenger cars for delivery to the Chilean State Railways.

Don Manuel Trucco Ambassador of Chile, received the equipment on behalf of his government. Robert S. Binkerd, vice-president and director of sales of the Baldwin Locomotive Works, and S. M. Bash, vice-president of the Bethlehem Steel Export Corporation, conveyed greetings for American industry. The affair was followed by a dinner to the ambassador and to the consular officials representing Latin American countries.

P. R. R. Shop Employees Organize

Representatives of the Pennsylvania's shop crafts employees, at a recent meeting in New York, organized a new association which it is contemplated will become affiliated with the recently-organized Brotherhood of Railroad Shop Crafts of America. The latter, which was formed last July, as reported in the October *Railway Mechanical Engineer,* is a new shop-crafts labor-movement, having no connection with the American Federation of Labor and designed to afford railway shop employees an opportunity to conduct their affairs independently of the latter.

The newly organized unit of P. R. R. employees elected the following officers: President, T. H. Davis, Woodlyne, N. J.; system vice-president, E. W. McClain, Harrisburg, Pa.; system secretary-treasurer, Paul Reese, Ft. Wayne, Ind. Mr. Davis is also national organizer for the Brotherhood of Railroad Shop Crafts of America. The delegates at the New York meeting also appointed a system negotiating committee to meet with the Pennsylvania management for the purpose of formulating a set of rules, working conditions and rate schedules for shopmen. They further voted to establish a system board of adjustment for the settlement of grievances.

Mediation Board Certifies Employee Representation

Following elections of shop employees the National Mediation Board has issued the following certifications:

On the Spokane, Portland & Seattle the Railway Employees' Department of the American Federation of Labor has been duly designated and authorized to represent the crafts of machinists, boilermakers, blacksmiths, sheet metal workers, firemen and oilers, and their helpers and apprentices.

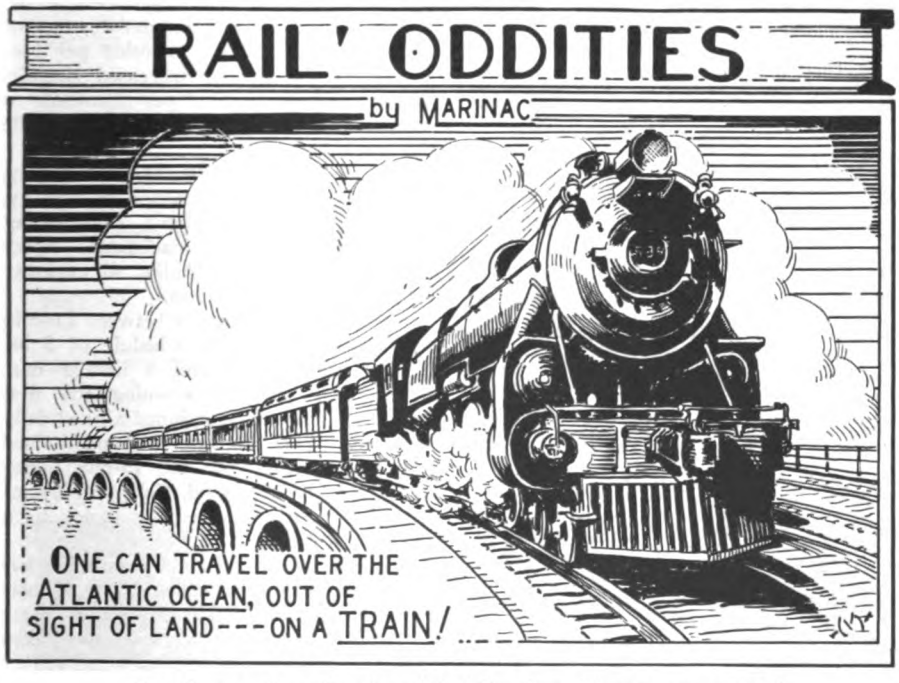
On the Great Northern the Associated Organizations of Shop Craft Employees has been designated to represent the crafts of electrical workers, carmen, and their helpers and apprentices.

On the Atlantic, Birmingham & Coast the board has certified that the Metal Trades Crafts Association, Atlanta, Birmingham & Coast Railroad, has been authorized to represent the machinists, boilermakers, blacksmiths, sheet metal workers, and electrical workers and their helpers and apprentices, and that the Association of Car Employees has been authorized to represent the carmen, and their helpers and apprentices.

Eastman Investigates Sale and Handling of Scrap

On October 26, 1934, the Federal Coordinator of Transportation addressed to the railroads an inquiry prepared by his Section of Purchases concerning the handling and sale of scrap. The purpose is to develop information on: (1) The costs of handling and preparing scrap for the market and the net revenue accruing to the railroads through the sale of scrap; (2) the advantages and disadvantages of dismantling equipment versus sale "on wheels," or dismantling by outside agencies; (3) the possibilities for economy through the establishment of central scrap plants to serve two or more roads, and (4) the relative position of the railroads as scrap producers.

* * *



Further explanation furnished by the editor upon request

The inquiry will develop information on the total amount of scrap originated by the railroads for the five years, 1929 to 1933; the amount shipped direct from point of origin and the amount handled through scrap sorting plants, for both ferrous scrap and non-ferrous metal scrap. The amount of each class of prepared scrap shipped during 1933 and the market into which it moved will be determined, together with the money received for the scrap. Because of the effect of freight haul on price, the ton-miles of haul, both free and revenue, and the freight revenue received are given due place in the inquiry.

The number of locomotives and cars dismantled, sold "on wheels" and sold under other agreements, together with total weight, terms of sale and money received, is also requested.

"There is wide variation in what meager information is at present available on the cost of scrap plant and dismantling operations," Mr. Eastman said. "The inquiry contains well defined questions dealing with those items which will secure figures on the individual features of cost and will develop comparable figures. From the returns as a whole, it will be possible to place before the railroads a more complete and authoritative picture of their scrap handling operations than has ever been available, and one which will provide the basis for a concerted attack on many problems, the solution of which should result in improved efficiency."

Details, such as locations of scrap plants, size, capacity, facilities used, and kind of operations performed in each, will also be covered by the inquiry.

New Equipment

Car Orders

Road	No. of cars	Type of car	Builder
Ill. Central	1[1]	5-car artic. train	Pullman Car & Mfg. Co.
Mesta Machine Co.	2[2]	100-ton flat	Std. Steel Car Corp.
	2[2]	100-ton gondola	
Mexican Ry.	30	40-ton box	Pressed Steel Car Co.
	20	Automobile	

Car Inquiries

D. & R. G. W.	2 to 4	Dining	.....
Minnesota Mining & Mfg. Co.	25 to 100[3]	70-ton hopper	.....
Nov. Pac.	24	Light-weight de luxe coaches	.....

Locomotive Orders

Road	No. of locos.	Type of locomotive	Builder
A. T. & S. F.	1	3,600 hp. Diesel-elec.[4]	Winton Engine Co.
Ill. Central	8[5]	Diesel-elec. switch	American Loco. Co.
	1[5]	Diesel-elec. transfer	Busch-Sulzer Bros. Diesel Engine Co.
	1[5]	Diesel-elec. transfer	Winton Engine Co.
	1[5]	Diesel-elec. transfer	Ingersoll-Rand Co.
Pennsylvania	57	Electric	See Note 6.

Miscellaneous Orders

Road	Type of equip.	For use on	Order placed with
Boston & Maine	Jour. bear. and boxes	New streamlined "Flying Yankee"	Hyatt Roller Bearing Co.
	Isothermos journal boxes	See Note 7.	Nat'l Malleable & Steel Cast. Co.
Grand Trunk Western	Engine truck bearings	4 pass. locos.	Timken Roller Bearing Co.
Ill. Central	Auto loaders	400 auto cars	Evans Products Co.
N. & W.	Loco. valve pilot	1 frt. loco.	Valve Pilot Corp.

[1] This five-car, streamlined, articulated, Diesel-electric, Cor-Ten steel passenger train is intended for use between Chicago and St. Louis, Mo., and will operate on a schedule of less than five hours, making a round trip daily. The train, which will be built in the Pullman shops at Chicago and which will cost $400,000, will be delivered next spring. The train, which will weigh 250 tons loaded and which will have an overall length of 330 ft., will replace two six-car steam trains weighing 601 tons with locomotive and tender. It will be propelled by a Winton Engine Company 1,200-hp. Diesel-electric engine for which the electrical equipment will be furnished by the General Electric Company.

The five cars, all of which will be air-conditioned and which will have a seating capacity for 150 passengers, will include a motor car, a baggage, mail and express car, two chair cars and a lounge car. Cor-Ten steel, a product of the United States Steel Corporation, will be used in the framework, while aluminum will be used in the remainder of the body and for the interior finish.

One of the distinctive features of the train will be its provision for dining service. An electrically-equipped kitchen in the lounge car will supply meals to dining tables located in that car and to seats in the chair cars, each of which will have a collapsible table.

[2] To be equipped with Timken roller bearings.

[3] Contemplated; inquiry not placed.

[4] Four power units of 900 hp. each. This locomotive will be used in pulling the "Chief" between Chicago and Los Angeles, Cal.

[5] These 11 locomotives constitute one of the largest orders ever placed for Diesel-electric locomotives and represent one of the major steps in the progressive elimination of steam operation on the Chicago terminal of the Illinois Central in accordance with the so-called Lake Front ordinance of 1919. The eight switchers to be built by the American Locomotive Company will be of 600 hp. The transfer locomotive to be constructed by the Busch Company will have a 2,000-hp. unit, the largest single motor yet ordered for railway service, while the remaining two transfer locomotives will be equipped with 1,800-hp. units. The electrical equipment for the transfer locomotives will be furnished by the General Electric Company, while the electrical equipment for the switching locomotives will be furnished by the Westinghouse Electric & Manufacturing Company. The contracts for this equipment, which will cost $1,200,000, provide for deliveries to begin on March 1, 1935, with completion by mid-year.

[6] This is one of the largest locomotive orders in the history of American railroading.

Costing almost $15,000,000, these new streamlined electrics have been specially designed for Pennsylvania's high speed passenger service to be inaugurated between New York, Philadelphia, Pa., Baltimore, Md., and Washington, D. C., early in 1935. They will be capable of making a regular operating speed of 90 miles an hour, and will haul trains of standard size and length. Twelve 57-in. driving wheels, six on each side, will drive the fully streamlined articulated locomotives with the full power of 4620 hp. at high speed.

The purchase is being financed through the P. W. A. and is a part of the Pennsylvania's seventy-seven million dollar improvement and equipment program, involving the New York-Washington roadway electrification and car and locomotive construction.

Eighteen complete locomotives will be built at the Pennsylvania's Altoona, Pa., Works, and the works also will apply the electrical propulsion and control apparatus to the chassis of 25 additional locomotives. The 25 chassis to be equipped at Altoona, will be built at the Baldwin Locomotive Works at Eddystone, Pa. The General Electric Company at Erie, Pa., will build 14 complete locomotives and the electrical propulsion and control apparatus for 9 others. The Westinghouse Electric & Manufacturing Company at Pittsburgh will build the electrical propulsion and control apparatus for 34 locomotives.

Each locomotive will cost in the neighborhood of $250,000 and will be 79½ ft. long, of all-steel construction and will weigh 460,000 lb. It will operate on an 11,000-volt, 25 cycle, single-phase system, the current to be fed by overhead wires through a pantagraph. Its maximum starting tractive effort will be 72,800 lb.

Two main frames, each resting on six driving wheels and a four-wheel engine truck, joined by an articulated or hinged joint, will support the body of the locomotive. Power will be furnished by six pairs of twin traction motors, each pair attached to a driving axle. Power will be transmitted to the driving wheels through quill mounted gears, permitting the free spring play of axles and wheels.

The new locomotives will form part of the Pennsylvania's fleet of more than 150 electric locomotives designed specially for the New York-Washington passenger and freight service. This is the second extensive locomotive order placed by the Pennsylvania in recent months. In July, the company placed orders to proceed with the construction of 28 electric passenger locomotives at a cost of over $6,000,000. Work on these locomotives is progressing rapidly, and they will be placed in service in the near future.

[7] For use under the tenders for the five new Pacific passenger locomotives now being built by the Lima Locomotive Works; five tenders of the Mountain type locomotives for freight and passenger service, now being built by the Baldwin Locomotive Works; and for 10 de luxe coaches now being built by the Pullman-Bradley Car Corporation.

Zephyr Increases Business

The Zephyr of the Chicago, Burlington & Quincy carried more than 100 persons on its first scheduled run between Lincoln, Neb., and Kansas City, Mo., on November 11. The demand for space in the 72-seat capacity train was so great that reservations were closed several days in advance when requests amounted to several hundred. In order to provide for holders of through tickets, the sale of tickets from Lincoln and Omaha was limited to 50.

Omitting the patronage of the train on the first day when its inauguration was attended with special ceremonies, 35 per cent more passengers rode on the train during the week of November 12 to 18 than had ridden the steam-drawn train in the preceding week. The average patronage between all points was 91 persons, as compared with 67 on the former train. A questionnaire given to passengers returned figures showing that 18 per cent traveled from curiosity; 67 per cent would have used Burlington steam train service anyhow, 10 per cent would have used some other steam train and 5 per cent would have gone by private automobile, bus or airplane. The distance traveled per passenger on the Zephyr increased sharply. 44 persons being carried per train-mile as compared with 21 persons per train-mile the week before.

On two trips, southbound on Saturday, November 17, and northbound on Sunday, November 18, the Zephyr's 72-passenger seating capacity proved inadequate. There were 90 passengers, including 41 curiosity riders, on the Sunday run.

The Zephyr is in service between Lincoln and Kansas City on a schedule of 5 hr. 30 min. southbound and 5 hr. 25 min. northbound, thereby becoming the first high speed train to be assigned a fixed daily schedule. The schedule was maintained each day, except for the 15-min. delay westbound at Greenwood, Neb., on November 13, when the Zephyr was struck by a farmer's truck.

The gross revenue per train-mile has been about $1.65, of which about $1 was from passengers, compared with passenger revenues of about 50 cents on the steam trains.

(*Turn to next left hand page*)

RAILROADING HAS CHANGED



When freights were speeded to 40 miles per hour; when locomotives were built with 1,000 horsepower per axle; when 1,000-mile runs were instituted, the old materials became inadequate. » » Don't expect of ordinary carbon steel impossible qualities of strength and shock resistance. Meet the new conditions with alloy steels and irons developed for specific railroad conditions. » » Agathan alloy staybolts will withstand the higher boiler pressures; special alloy sheets will reduce maintenance in large fireboxes. » » The greater stresses in pins, rods and axles find Republic ready with special Agathon alloy steels for this service. Agathon Nickel Iron combines surface hardness for wear resistance with a tough, shock-resisting core. » » These are but a few of the many special railroad materials with which Republic is helping the railroads meet the new operating conditions.

Republic Double Strength Steel for Transportation Industry • Toncan Iron Boiler Tubes Pipe, Plates Culverts Rivets Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

AGATHON NICKEL IRON

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES YOUNGSTOWN, OHIO
Reg. U. S. Pat. Off.

AGATHON STEELS

Supply Trade Notes

LOUIS M. SHINE has been appointed railway sales manager of the Standard Varnish Works, with offices at 386 Fourth avenue, New York City.

FRANCIS D. BARTOW was elected a member of the board of directors of the General Electric Company at a meeting of the board on October 26.

THE HENRY J. LINN COMPANY, 250 Stuart street, Boston, Mass., has been appointed New England sales agent for the Globe Steel Tubes Company, Milwaukee, Wis.

RALPH R. WEDDELL, consulting engineer, has become identified with the Ingersoll Milling Machine Company, Rockford, Ill., in charge of the design and sale of small tools.

MAURICE E. O'BRIEN and Moxie S. George have entered the employ of the Inland Steel Company as salesmen, the former in the Chicago office and the latter in the Milwaukee, Wis., office.

ROBERT J. WORKING, assistant district sales manager of the Republic Steel Corporation, with headquarters at Cincinnati, Ohio, has been appointed district sales manager, with the same headquarters, to succeed W. A. Peck.

A. P. MARWICK, who was formerly in the sales department at Chicago, of the Taylor-Wharton Iron & Steel Company, High Bridge, N. J., has been appointed sales manager of the Burnside Steel Foundry Company, Chicago.

OSTER-WILLIAMS COMPANY of Cleveland, Ohio, manufacturers of pipe and bolt-threading equipment, have opened an office and display room at 292 Lafayette street, New York, in charge of H. B. Van Osten, district manager. All machines will be available for actual threading demonstrations.

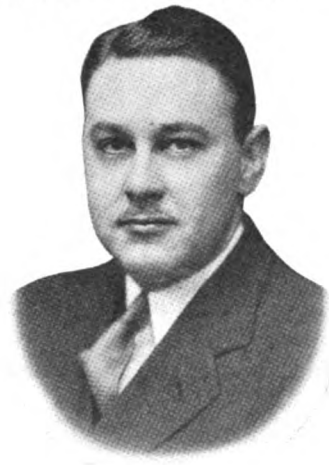
CHARLES H. REINERT, formerly superintendent of the Brooklyn plant of Steel and Tubes, Inc., has become asssitant superintendent of the electric weld tube mill of the company at Youngstown, Ohio. M. B. Steel, until recently a sales engineer working out of the Cleveland office of Steel and Tubes, Inc., is now assisting E. T. Glass, sales manager of the New England division, at Boston, Mass.

RUSSELL E. COLGATE, chairman of the board of the Tyson Roller Bearing Corporation, Massillon, Ohio, has been elected president and treasurer succeeding Charles E. Stuart, who has resigned as president and treasurer, but will remain on the board of directors. Ralph H. Maxson is executive vice-president in charge of operations; George C. McMullen, vice-president in charge of sales; George Neupower, secretary, and E. R. Ernest, assistant treasurer and purchasing agent.

THE AMERICAN ROLLING MILL COMPANY, Middletown, Ohio, has established a new sales office in the Citizens and Southern National Bank building, Atlanta, Ga. C. M. Broome, Jr., is assistant district manager in charge of this office. The new Armco sales office will serve the states of Florida, South Carolina, Alabama, Georgia and parts of Tennessee and North Carolina, which territory was formerly covered by the Middletown district office.

THE EDWARD G. BUDD MANUFACTURING COMPANY, Philadelphia, Pa., in connection with the construction of light weight high speed trains and other units has built special dies, jigs, tools, welding equipment, etc. This equipment is installed in one of its large buildings in the Philadelphia plant which has been rebuilt for straight line production with two tracks running down through its center, with the necessary wells and pits. These tracks connect with the yard where ample rail storage facilities are being provided also with both the Pennsylvania and the main line of the Reading. Three trains are under construction—one for the Chicago, Burlington & Quincy and two for the Boston & Maine. The company now employs over 1500 men on three shifts.

F. R. KOHNSTAMM has been appointed manager of the Lighting division of the Westinghouse Electric & Manufacturing Company. In his new position, he will have supervision over all lighting activities,



F. R. Kohnstamm

including sales, engineering and manufacturing, now conducted at the Westinghouse Cleveland Works, in Edgewater Park, Ohio. Mr. Kohnstamm, a native of Scranton, Pa., has been associated with the Westinghouse Company since 1917. He was located in East Pittsburgh for the first two years of his service. In 1919 he was transferred to Mansfield, Ohio, where new headquarters for the company's merchandising department had been established. In 1922 he was made manager of the appliance division of this department. Five years later, in 1927, he was appointed assistant sales manager of the same department and, in 1931, he became director of merchandise. Early in 1933, he returned to the East Pittsburgh, Pa., headquarters of the company as sales promotion manager. He held that position until his present appointment and transfer to Cleveland.

WHITLEY B. MOORE has been appointed general manager of the Industrial division of the Timken Roller Bearing Company, Canton, Ohio. Mr. Moore was graduated from the University of Michigan in 1918, going immediately into service in the U. S. Navy. At the close of the war, he joined the engineering staff of The Timken Roller Bearing Company. In 1921, Mr. Moore was transferred to the Pacific coast in charge of sales in that territory. In 1924 he returned to Canton as assistant general sales manager of the Industrial division and since 1930 was sales manager.

L. M. KLINEDINST, vice-president in charge of all industrial sales of the Timken Roller Bearing Company, Canton, Ohio, has been elected to the board and also promoted to the office of vice-president in charge of sales, to fill the vacancy created by the recent resignation of Judd W. Spray. T. V. Buckwalter, who has been vice-president of the Timken Roller Bearing Company for several years, has been elected vice-president and director of the Timken Steel & Tube Company. Mr. Klinedinst has been associated with the Timken Company since leaving school 29 years ago. After serving in various junior executive positions in both the manufacturing and selling divisions he was identified with automotive development work for many years, serving as assistant sales manager. In 1921 he was appointed general manager of the Industrial division, and since 1930 has been vice-president in charge of all industrial sales.

FRED W. VENTON, assistant manager of the railroad sales department of the Crane Company, Chicago, has been promoted to manager of that department, with the same headquarters. He was born in Cleveland, Ohio, on November 14, 1881, and was educated at Armour Institute of Technology, Chicago. During the early part of his

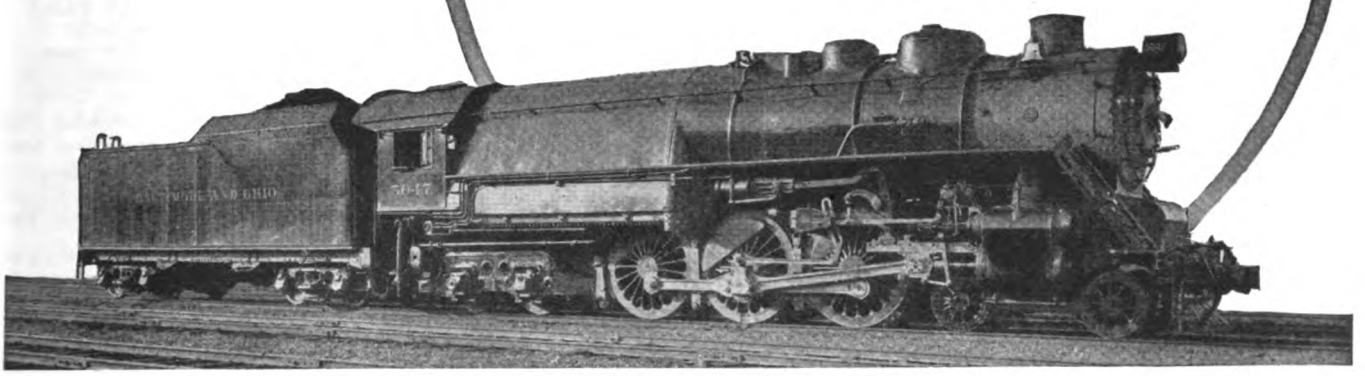


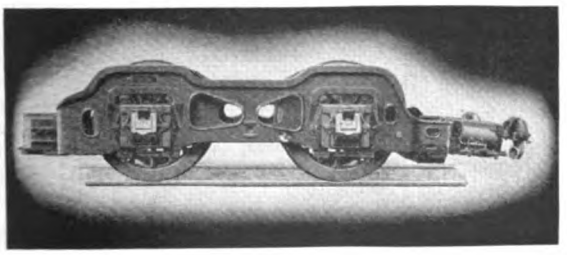
Fred W. Venton

career he was employed in the shops of the L. H. Prentice Company, and the Chicago, Burlington & Quincy, while later he served as chief engineer of several hotels in Chicago and of the McClintock estate. In 1910, he entered the employ of the Crane Company as traveling engineer and in 1915 was promoted to assistant manager of the railroad sales department.

(*Turn to next left hand page*)

THE BOOSTER *is an Invaluable AND Integral Part of the Locomotive*





The higher the efficiency with which a locomotive operates over a division the greater the return on the investment and the greater the net earnings.

Booster-equipped, to aid in starting, accelerating and over the ruling grades, the locomotive can produce more ton-miles-per-hour, or, a smaller locomotive can produce the same ton-miles-per-hour.

This permits operating the locomotive at more nearly its maximum efficiency a greater part of the time than would be possible if the maximum demand for power had to be provided by the two larger main cylinders.

In the design of new locomotives the Booster is as essentially an integral part of the locomotive as the main cylinders and driving wheels.

By incorporating the Booster in the original design it permits of a lighter, lower cost locomotive that will be more economical both to operate and to maintain.

No locomotive device is better than the replacement part used for maintenance.
Genuine Franklin repair parts assure accuracy of fit and reliability of performance.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

Obituary

HARRY U. MORTON, president of the Morton Manufacturing Company, Chicago, died in that city on November 11. He had been inactive in company affairs for two years due to ill health. For 18 years before the organization of his own company in 1913, Mr. Morton had been associated with the Pullman Company.

LEWIS W. METZGER, formerly in charge of estimating and accounting work and assistant to the vice-president in charge of sales of the Baldwin Locomotive Works, Philadelphia, Pa., died on November 13 at his home in Mount Airy, a suburb of Philadelphia, at the age of 79. Mr. Metzger had retired five years ago after a service of over half a century with the Baldwin company.

EDWARD MCCORMICK, who, prior to November, 1931, had been vice-president in charge of sales of the Railway Steel-Spring Company, at New York, died on October 27 at his home in Brooklyn, N. Y., at the age of 58. Mr. McCormick, who in 1919 was treasurer of this company, which is now the Railway Steel-Spring division of the American Locomotive Company, was in that year appointed assistant to the president and the following year was elected vice-president. He first served as vice-president in charge of financial affairs and in 1927 became vice-president in charge of sales. At the time of his death Mr. McCormick was head of a bond brokerage firm under his name in Brooklyn.

WILLIAM W. DARROW, president of the Camel Company, Chicago, died on November 18, at Philadelphia, Pa., where he had gone on a business trip. Mr. Darrow was stricken with a heart attack on November



William W. Darrow

14, and was taken to the Temple University hospital in Philadelphia, where he died. Mr. Darrow was born on August 29, 1882, at Janesville, Wis., and graduated from the Chicago high schools. His entire business career was spent in the service of the Camel Company. He went with the company in 1901, and five years later was advanced to secretary. In 1915 he was appointed vice-president, and in 1923 was elected to the presidency. Mr. Darrow was also president of the Camel Sales Company.

Personal Mention

General

D. K. CHASE, master mechanic of the Pittsburgh-Conemaugh-Monongahela division of the Pennsylvania, has been appointed superintendent of the Toledo division with headquarters at Toledo, Ohio.

Master Mechanics and Road Foreman

H. T. COVER, assistant master mechanic of the Pennsylvania at Wilmington, Del., has been appointed master mechanic of the Buffalo division.

L. W. MILLER has been appointed master mechanic of the Port Huron & Detroit, with headquarters at Port Huron, Mich., to succeed James W. North.

H. J. KLEINE, assistant enginehouse foreman of the Pennsylvania, has been appointed assistant master mechanic, with headquarters at Wilmington, Del.

WALTER BUDWELL, general foreman of the Shaffers Crossing shop, of the Norfolk & Western, at Roanoke, Va., has been promoted to the position of master mechanic of the Norfolk division, with headquarters at Crewe, Va., succeeding W. J. Yingling, deceased.

Shop and Enginehouse

A. L. BROWN, enginehouse foreman of the Norfolk & Western at Bluefield, W. Va., has been transferred to the position of enginehouse foreman at Crewe, Va.

R. J. BARRY, assistant enginehouse foreman of the Norfolk & Western at Shaffer's Crossing, Va., has been promoted to the position of enginehouse foreman.

ROY GABLE, enginehouse foreman of the Norfolk & Western at Shaffer's Crossing, Va., has been transferred to the position of assistant enginehouse foreman at Portsmouth, Ohio.

L. E. BERRY, assistant enginehouse foreman of the Norfolk & Western at Portsmouth, Ohio, has been promoted to the position of enginehouse foreman, with headquarters at Bluefield, W. Va.

C. M. PETTREY, enginehouse foreman of the Norfolk & Western at Crewe, Va., has been promoted to the position of general foreman, with headquarters at Shaffer's Crossing, Va.

Obituary

WILLIAM J. GIVEN, division storekeeper on the Mobile & Ohio, with headquarters at Jackson, Tenn., died on October 29 at his home at Jackson.

WILLIAM C. LANG, master car builder of the Pittsburgh & Lake Erie, at McKees Rocks, Pa., was killed in an automobile accident on October 27. Mr. Lang was born on January 5, 1881, and in April, 1903, entered the service of the Pittsburgh & Lake Erie as a clerk at McKees Rocks. He became gang foreman in January, 1905, and was appointed assistant general foreman of car service in November, 1908. In August, 1915, he was appointed general car inspector at McKees Rocks, becoming pilot chief of the Electric division at Grand Central terminal for the New York Central in July, 1918. The following month he returned to the Pittsburgh & Lake Erie as general car inspector at McKees Rocks and subsequently became master car builder.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

LINDE PRODUCTS.—"Recommended Practices for Gas Cutting of Structural Steel" and "Precautions and Safe Practices" are the titles of booklets recently issued by the Linde Air Products Company, New York.

MILBURN EQUIPMENT.—O x y-acetylene apparatus, cutting and welding tips, paint-spray equipment and portable carbide lights are among the listings in the 1934-35 catalog of the Alexander Milburn Company, 1416 W. Baltimore street, Baltimore, Md.

ALLOY-STEEL BOILER PLATE.—Specifications for chrome-manganese silicon alloy steel boiler plate are given in the reprint from the 1934 addenda to Material Specifications Section, A.S.M.E. Boiler Construction Code, being issued by the Lukens Steel Company, Coatesville, Pa.

UNIVERSAL TURRET LATHES.—A new line of Ram type universal turret lathes is described in the 32-page catalog issued by the Jones & Lamson Machine Company, Springfield, Vt. Complete specifications, photographs and line cuts of the tools, with dimensions, are included in the catalog.

SHEET IRON.—The fifth edition of "Sheet Iron—A Primer," issued by the Republic Steel Corporation, Massillon, Ohio, contains 64 illustrated pages, which tell, in simple, non-technical language, the step-by-step story of modern manufacture of sheet iron. Production is traced from the ore mine to the final inspection of the completed sheet. The booklet also contains gage tables and a glossary of metallurgical terms.

MOTIVE POWER BATTERIES.—Bulletin No. 952, published by the Gould Storage Battery Corporation, Depew, N. Y., describes and classifies Gould armored Kathanode storage batteries, made for use on Diesel and gas-electric locomotives, articulated trains and motor cars. Tables are given for the various types of cells, which show capacity, charging rates, overall dimensions and weights. A feature of the bulletin is a graphical method for determining required battery capacity.

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Railway Mechanical Engineer

DEC 15 1934

December, 1934

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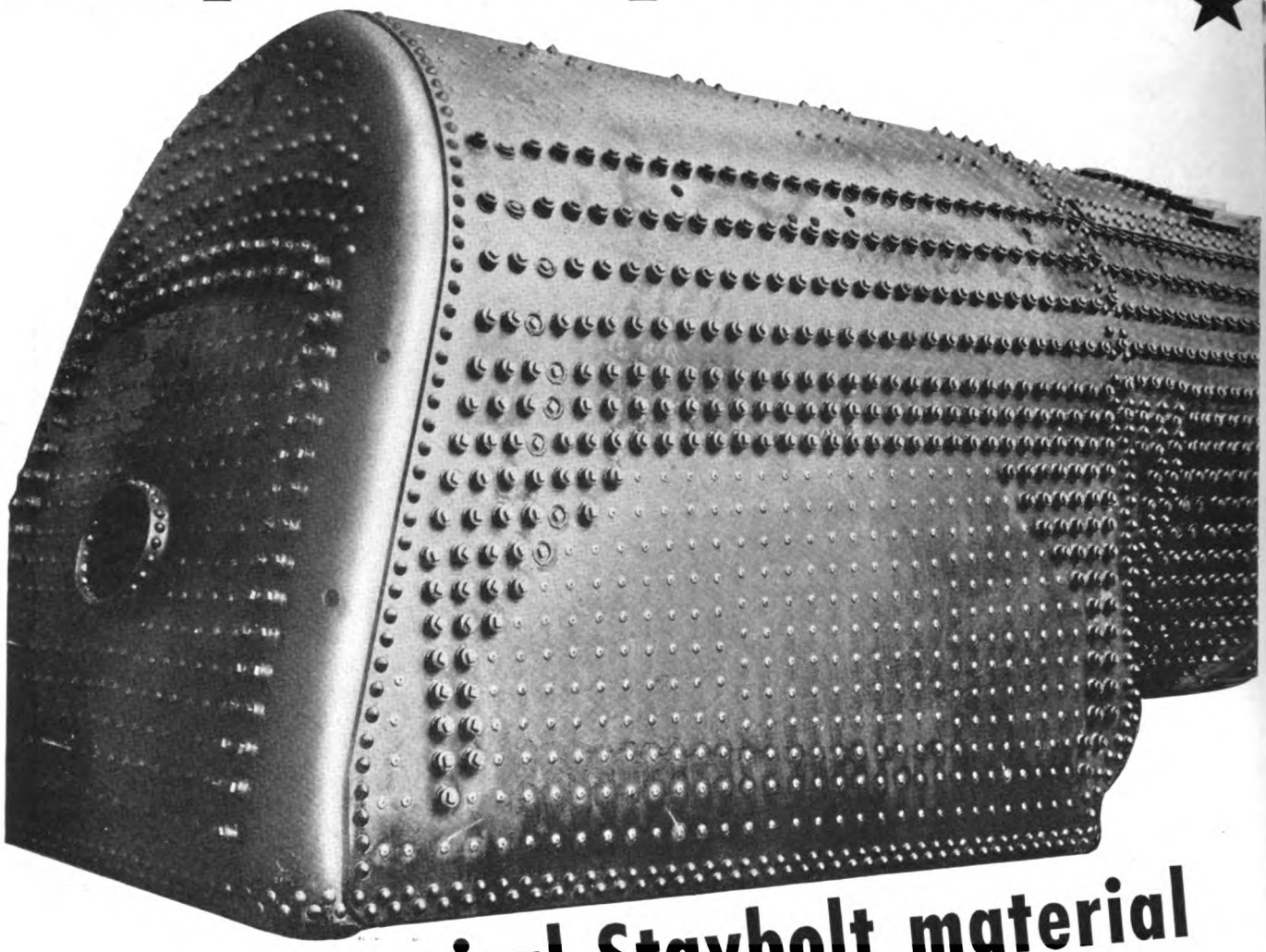
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The most trying conditions have proved the stamina and reliability of Mayari Staybolt Steel. On mountain runs with heavy firing that runs up fire-box temperatures. In cold northern climates that chill the fire-box every time the door is opened; that subject staybolts to an extreme temperature range when firing-up.

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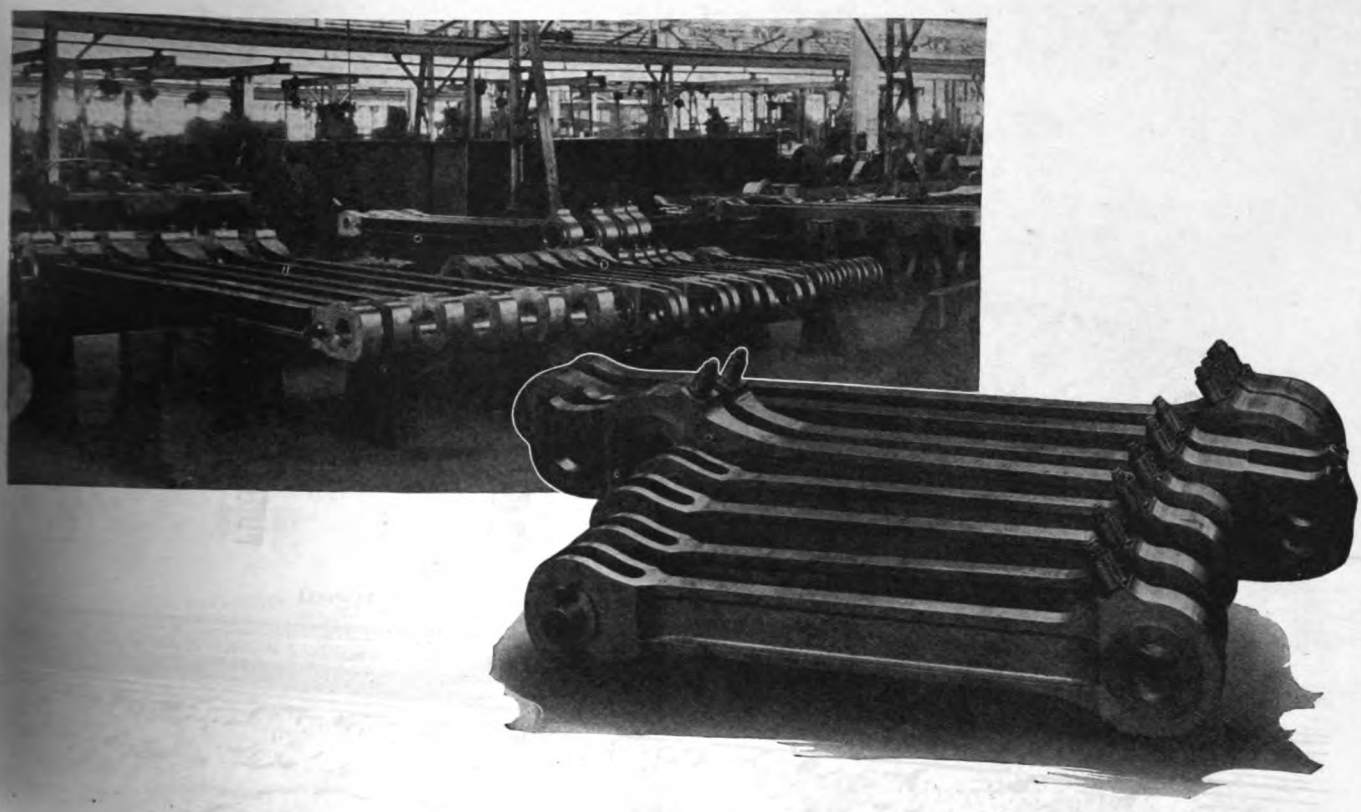
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VOL. 108 No. 12
Published monthly by Simmons-Boardman Publishing Company, 1309 Noble Street, Philadelphia, Pa. Entered as second class matter, April 3, 1933, at the Post Office at Philadelphia, Pa., under the act of March 3, 1879.



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is essential for true economy when purchasing vital locomotive parts such as connecting rods.

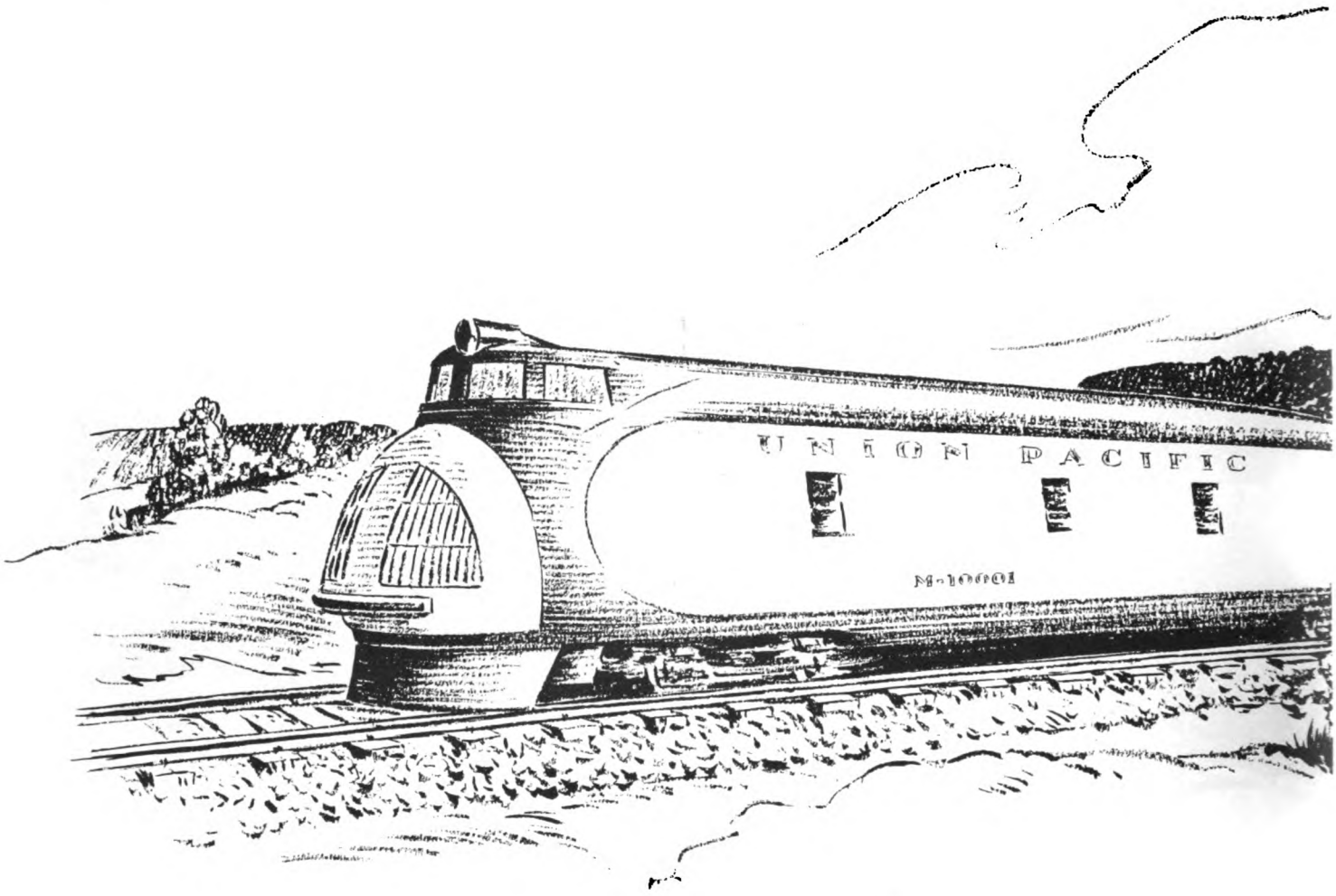
Their true cost must be measured in terms of the miles of satisfactory service delivered—in freedom from road delays and expensive detention in shops.

Even from the point of view of first cost we can offer competitive prices for high quality in materials and workmanship.

May we not quote on your requirements for connecting rods?

THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA



POWERED with GENERAL

UNION PACIFIC STREAMLINER

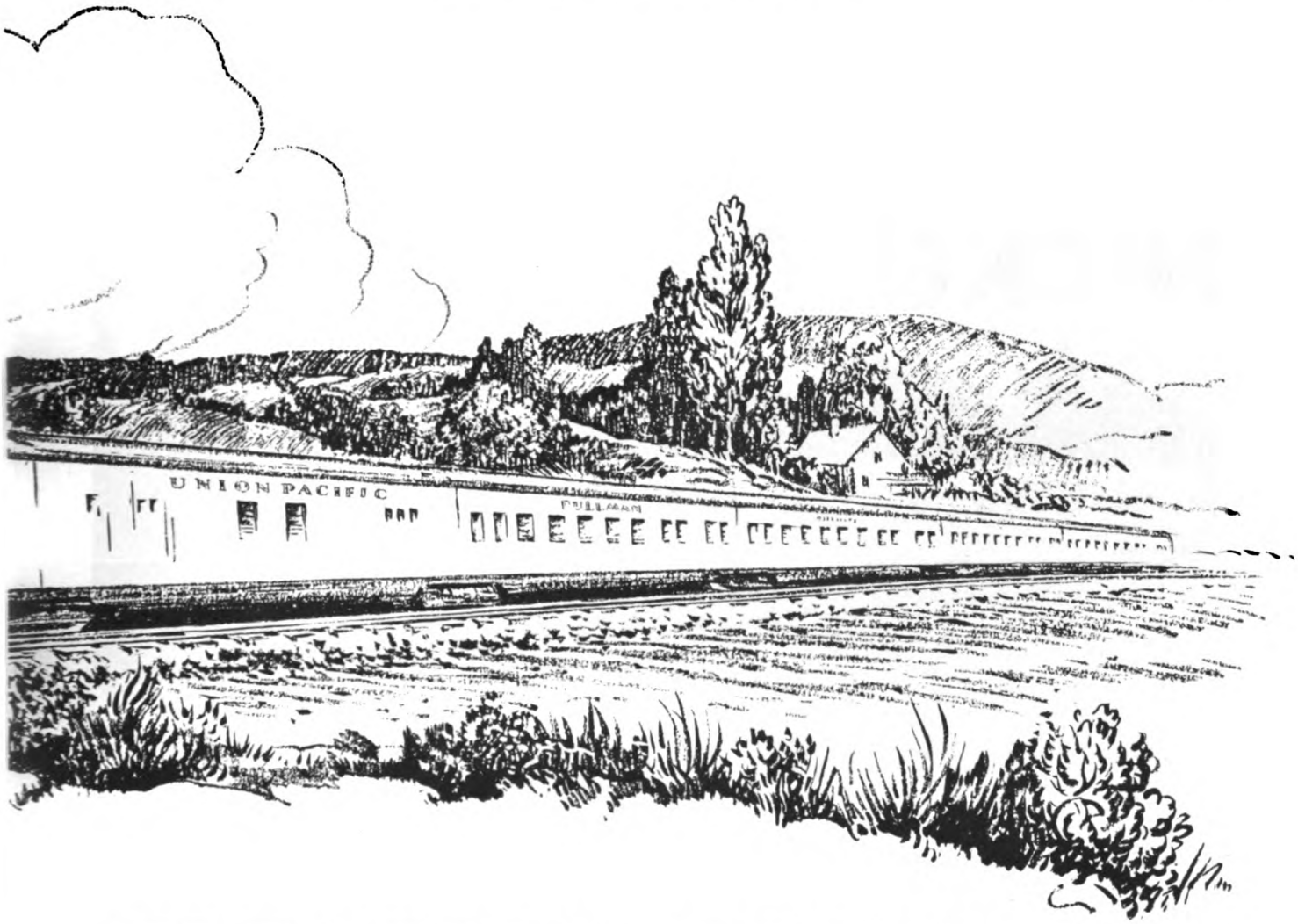
ANOTHER PROOF

THE new Union Pacific 6-car, 900-hp. Streamliner, built by Pullman, equipped with General Electric drive, and powered by a Winton Diesel engine, has set new records of speed and of transportation economy for all parts of the country. On its record-breaking coast-to-coast run, this train averaged 57.2 miles an hour, including all stops. Leaving San Bernardino, it maintained 20 mph. up a 23-mile 2.2-per-cent grade. On the plains of Nebraska, it covered two miles in 60 seconds.

In the 3258-mile run across country, the fuel consumption was 2075 gallons of fuel oil, costing a total of $83. This included oil burned for heating the train.

The train performed perfectly during the entire run, and when it reached New York a complete check of the power plant—engine, generators, motors, control, and compressors—proved everything to be in excellent condition. Not even adjustments were necessary before the train started back on its exhibition tour.

GENERAL



ELECTRIC DRIVE this HAS SHATTERED RECORDS

of the Dependability of Electric Drive

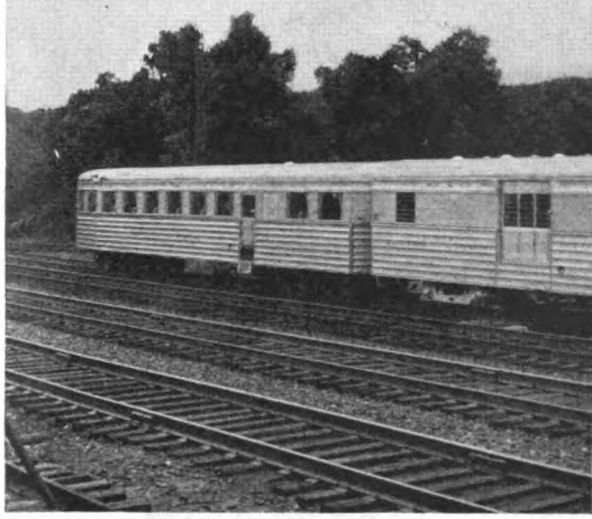
General Electric drive meets every requirement of maintenance. It gives thoroughly successful service at greatly reduced operating cost. Its reliable operation results from accumulated experience of 30 years with electric drive. G-E equipped cars have established enviable records of dependable operation.

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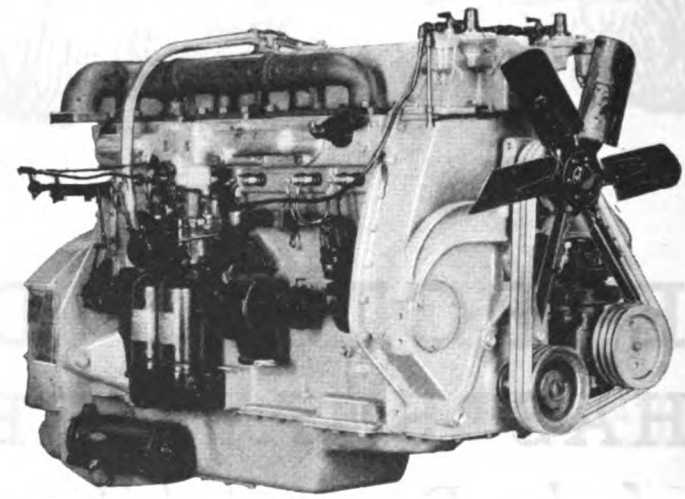
ELECTRIC

Engine of New Gas-Powered Train ...Made More Dependable with NICKEL CAST IRON



Streamlined 2-car train with body constructed of stainless steel containing 8% nickel by the Budd "shotweld" system built for Texas & Pacific by E. G. Budd Manufacturing Co., Phila., Pa.

• • •



V-12 gasoline engine, 240 h.p. Nickel Cast Iron cylinder blocks, heads and sleeves. Exhaust manifolds of Ni-Resist. Made by American La France & Foamite Company, Elmira, N. Y.

ANOTHER gas-powered train takes the rails in the battle against high operating costs.

The one pictured above has just been built for the Texas & Pacific. High-spots of interest are light weight with strength, high speed with safety, air conditioning and pneumatic tires.

Motive power consists of two V-12, 240 h. p. engines, each connected to a 600-volt generator, which in turn feed four 300-volt driving motors.

The power plant of this modern flyer is naturally the last word in dependability, and therefore includes many important parts made of Nickel Cast Iron.

Blocks, heads, sleeves, manifolds

Nickel-chromium Cast Iron was specified for engine blocks because of its increased strength, density and uniform structure in both light and heavy sections; for cylinder sleeves because of its uniformly high hardness, machinability and excellent resistance to wear; for cylinder heads because of its hardness, strength, density and resistance to growth and corrosion.

To provide uniform properties in weight-saving castings designed with varying sections, it was imperative to have a material that possessed not only uniformity in general structural characteristics but ease of production in the foundry as well.

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Exhaust manifolds are of Ni-Resist, a Nickel Cast Iron containing 14% nickel, 6% copper and 2% chromium, specified because of its freedom from growth—an important consideration on engines operating under heavy duty conditions for long periods of time.

Nickel Cast Irons are filling a host of important roles in the railroad field. Let us supply you with the latest data. Our casting specialists will gladly cooperate in solving your foundry problems.

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Miners, refiners and rollers of Nickel . . . Sole producers of Monel Metal

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The majority of the Class I railroads of the country have been customers of the Oxweld Railroad Service Company for many years and continue to renew their patronage.

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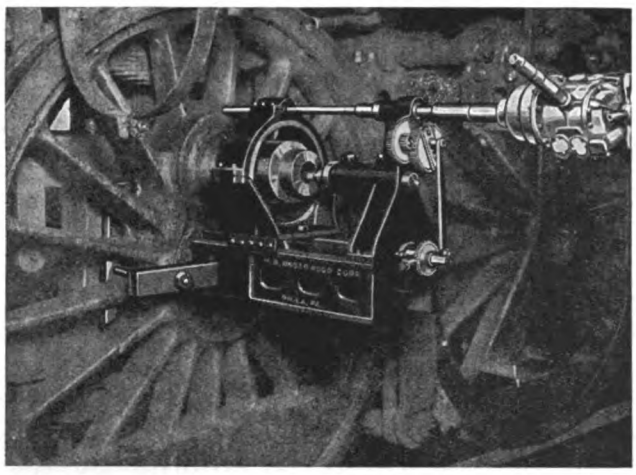
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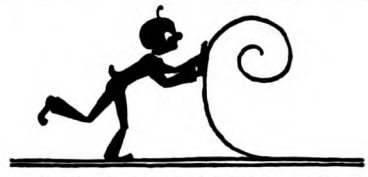
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The three grades of U S S High Tensile Steels here described have a wide range of adaptability, and are available at moderate cost. Supplied in Plates, Shapes, and Bars—also in Strips, Sheets, Light Plates, Rods, Wire and Wire Products, Pipe and Tubular Products.

NOTE: If Steels of still higher tensile strength and corrosion resistance are required, we recommend our U S S STAINLESS and Heat Resisting Steels, the practical maximum of these qualities being reached in the U S S 18-8 grade. Full data will be sent upon request.

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—a low Chromium Copper Silicon Steel of marked strength and utility. Resistance to atmospheric corrosion is conservatively estimated at from four to six times that of mild steel.

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— a lower-priced medium Manganese Steel of impressive strength, for uses where corrosion resistance of USS COR-TEN is not required.

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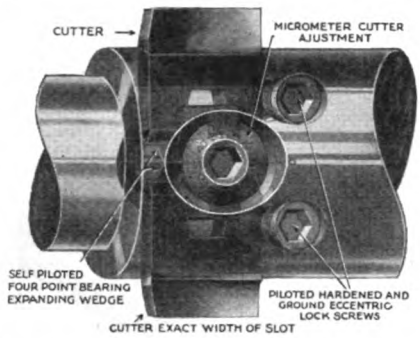
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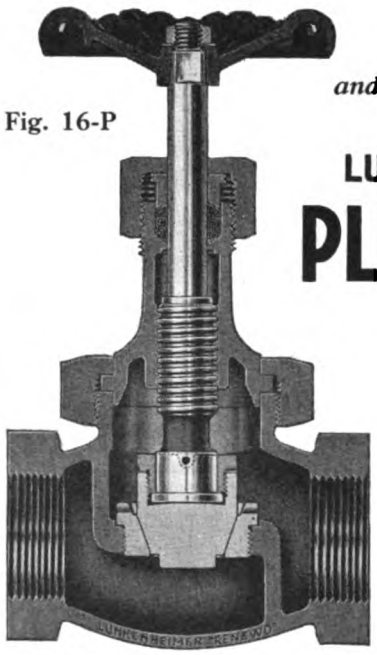
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Fig. 16-P



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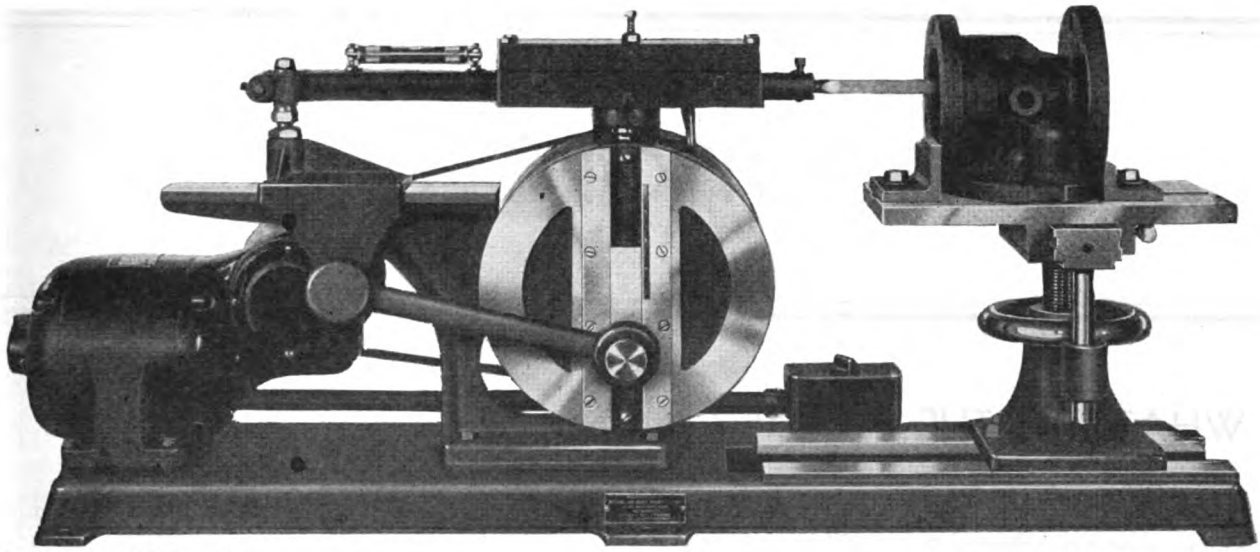
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THIS new book is a practical manual on the working of non-ferrous metal sheets and tubes. It is a complete treatment of the subject beginning with a detailed discussion and explanation of the materials, tools and equipment used. A minute description is given of all processes so that the apprentice and journeyman will find it particularly useful. Engineers and designers will be interested in gaining a knowledge of the processes, possibilities and limitations of copper and non-ferrous metal working.

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National Lapping Machine with K-2 triple valve in position.

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THE EDITOR'S DESK

WHAT OF THE FUTURE?

Congress meets next month. The Administration in various ways has indicated that it will favor legislation which will help strengthen the railways and restore them to a more prosperous condition. The Co-ordinator of Transportation, who is charged with the duty of recommending legislation to Congress, has not yet made known his program, but judging from his recent addresses, he will suggest measures of a favorable nature.

What Can Be Done?

The RAILWAY AGE, associated with the RAILWAY MECHANICAL ENGINEER as one of the family of Simmons-Boardman publications, on December 1 published a special number in the interests of securing a square deal for the railways, which promises to rank as one of the most outstanding achievements in the field of business paper journalism. Copies of it will go with individual letters to members of Congress, members of state legislatures, and to important governmental and transportation regulating authorities, etc.

Specifically what does it suggest?

National Recovery Depends on Durable Goods Industries

First, it demonstrates the importance of the durable goods industries to re-employment and to national recovery. It proves also that the railways, when prosperous, are one of the largest and most important purchasers of durable goods, these purchases directly affecting every part of the nation.

Railway Purchases Depend on Railway Net Earnings

The volume of railway purchases depends upon net earnings. After clearly demonstrating this, a survey is made of the ways and means by which earnings can be increased. These include a reasonable regulation of the railways' competitors and the elimination of subsidies which have been given to them; the proposed increase in freight rates; improvements in service which will enable the railways to compete more effectively with other common carriers; and possibilities of further operating economies. Then, also, the importance of credit is emphasized as a factor in increased buying by the railroads.

What the Railroads Want to Buy

The needs of the railways for materials, equipment and supplies are analyzed, special attention being given to prospective expenditures on rolling stock and shops. Here, as in other articles, attention is focused upon "steadily accumulating unrestored deterioration." In concluding this particular article, the statement is also made that "during the four years of the depression there has been a general suspension of the purchase of motive power, rolling stock and shop machinery. During this period new materials of construction, better designs and new conceptions of service have accelerated the growth of obsolescence of existing equipment. That the railways are alive to the importance of these developments and will take full advantage of them, when earnings permit the serious consideration of major expenditures on capital account, is evident from the attitude toward air conditioning and the disposition to undertake trials of new forms of equipment, even during the depression."

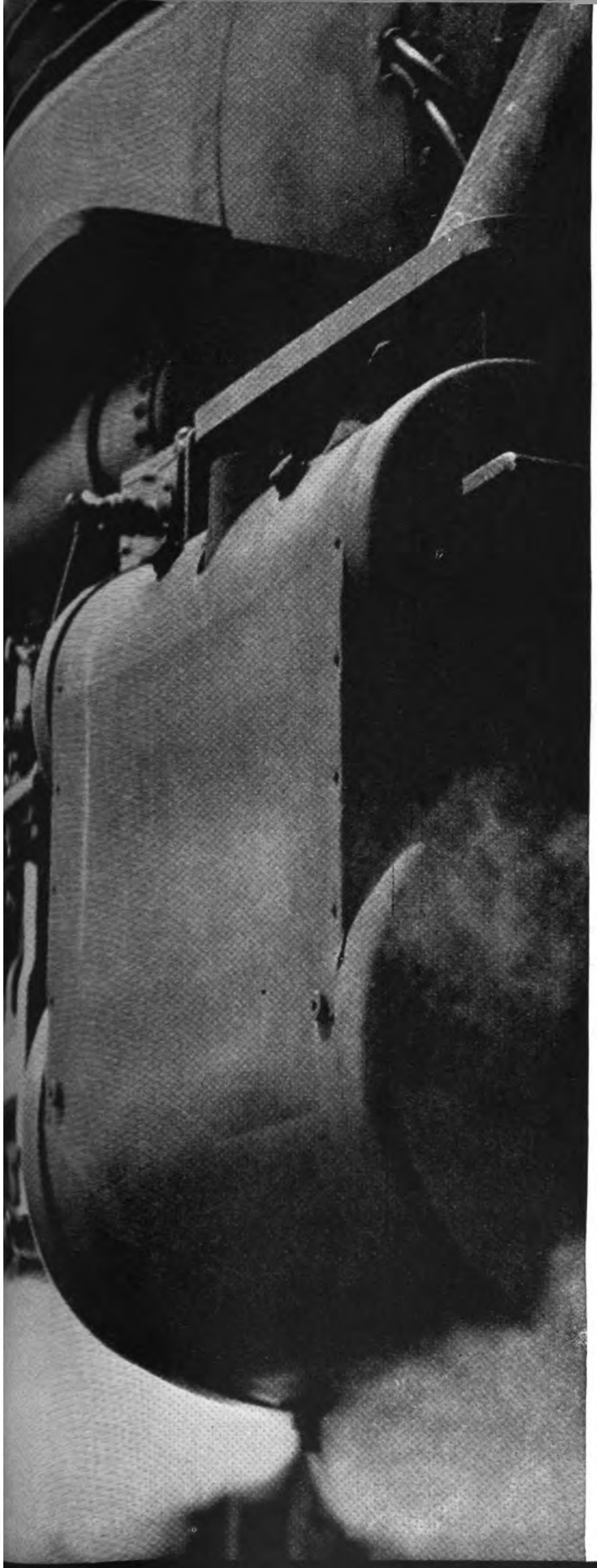
Other Factors in the Problem

There are, of course, other important factors involved in the solution of the transportation problem. The railways, for instance, are handicapped by the use of cheap labor by the highway and waterway carriers. Then there is the question of grade elimination and its bearing on the unemployment problem.

What WE Can Do to Help!

Use every bit of influence you and your friends may have to bring these facts home to those who are responsible for making laws — *state and federal.* Every one of us can bring some influence to bear upon our local representatives. We are not asking for special privilege or charity. All we want is a "Fair and Square Deal."

Roy V. Wright



. . . A word about a better VALVE OIL . . .

Dark rods and excessive carbon deposits point an accusing finger at the carbon-forming nature of most valve oil. The severe heat conditions under which valve lubricants must perform, subject them to tests which only a most unusual oil can pass.

Many factors contribute to the superiority of NONPAREIL Super-Heat VALVE OIL—but the simple and important fact to remember about it is that NONPAREIL *forms only one-sixth to one-third as much carbon as other valve oils.*

You'll agree that this is a vitally important development.

Standard Oil (Indiana) Engineers are ready to prove this low-oxidation characteristic of NONPAREIL VALVE OIL to you on your own locomotives, in your own service.

These Standard Oil men will also be glad to discuss any other lubrication problems you may have. You will find that they understand your equipment and problems. Call them in.

NONPAREIL SUPER-HEAT *Locomotive* VALVE OIL

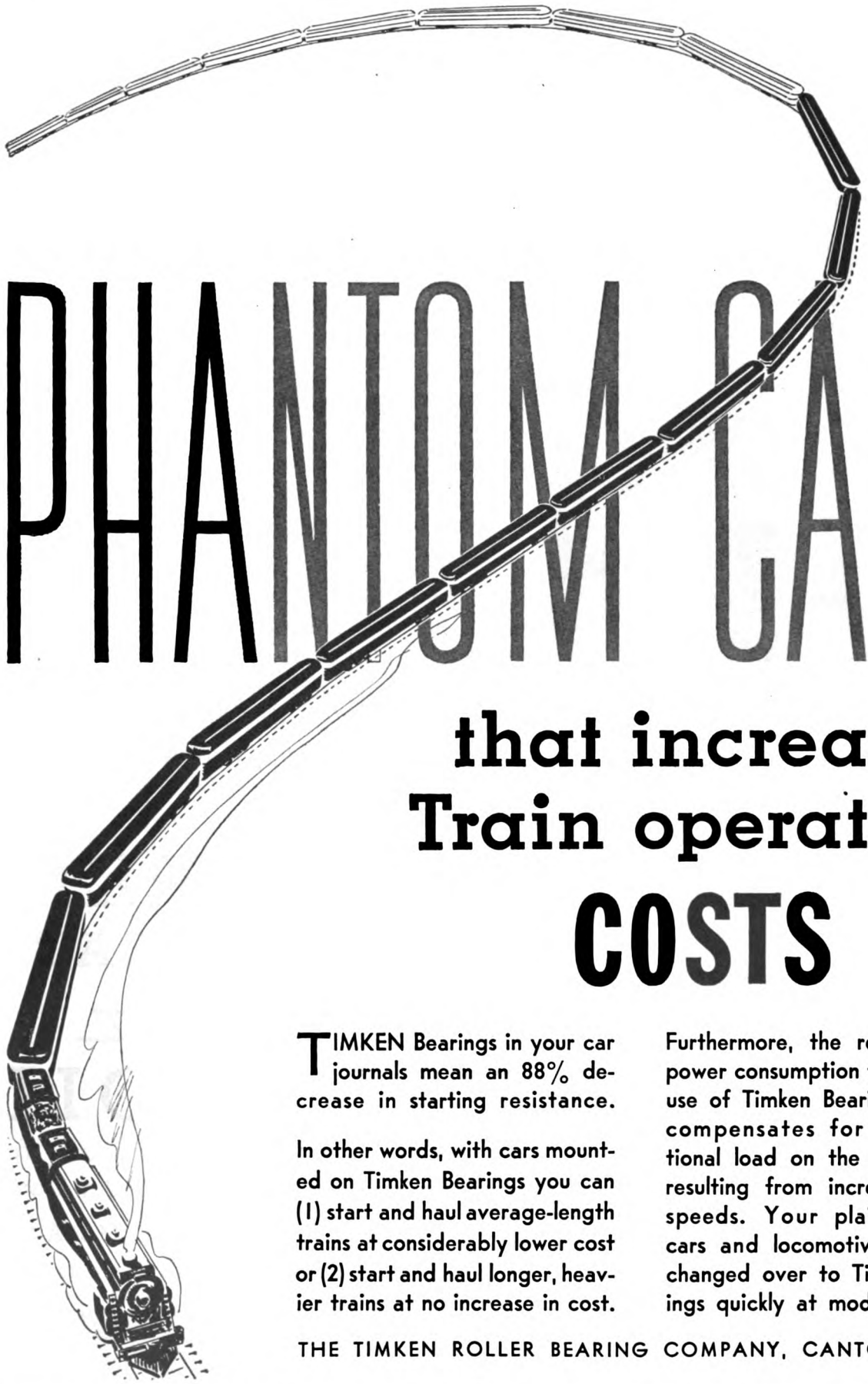
A greatly improved lubricant for Locomotive cylinders and valves

STANDARD OIL COMPANY
(INDIANA)
910 SOUTH MICHIGAN AVENUE, CHICAGO

Copr. 1934, Standard Oil Co.

TANDARD RAILWAY LUBRICANT

Standard Railway Lubricants, developed specifically for their work, are recommended to you by lubrication engineers who have a thorough knowledge of railway operation and the specific lubrication demands of every type of service.



PHANTOM CARS

that increase Train operating COSTS

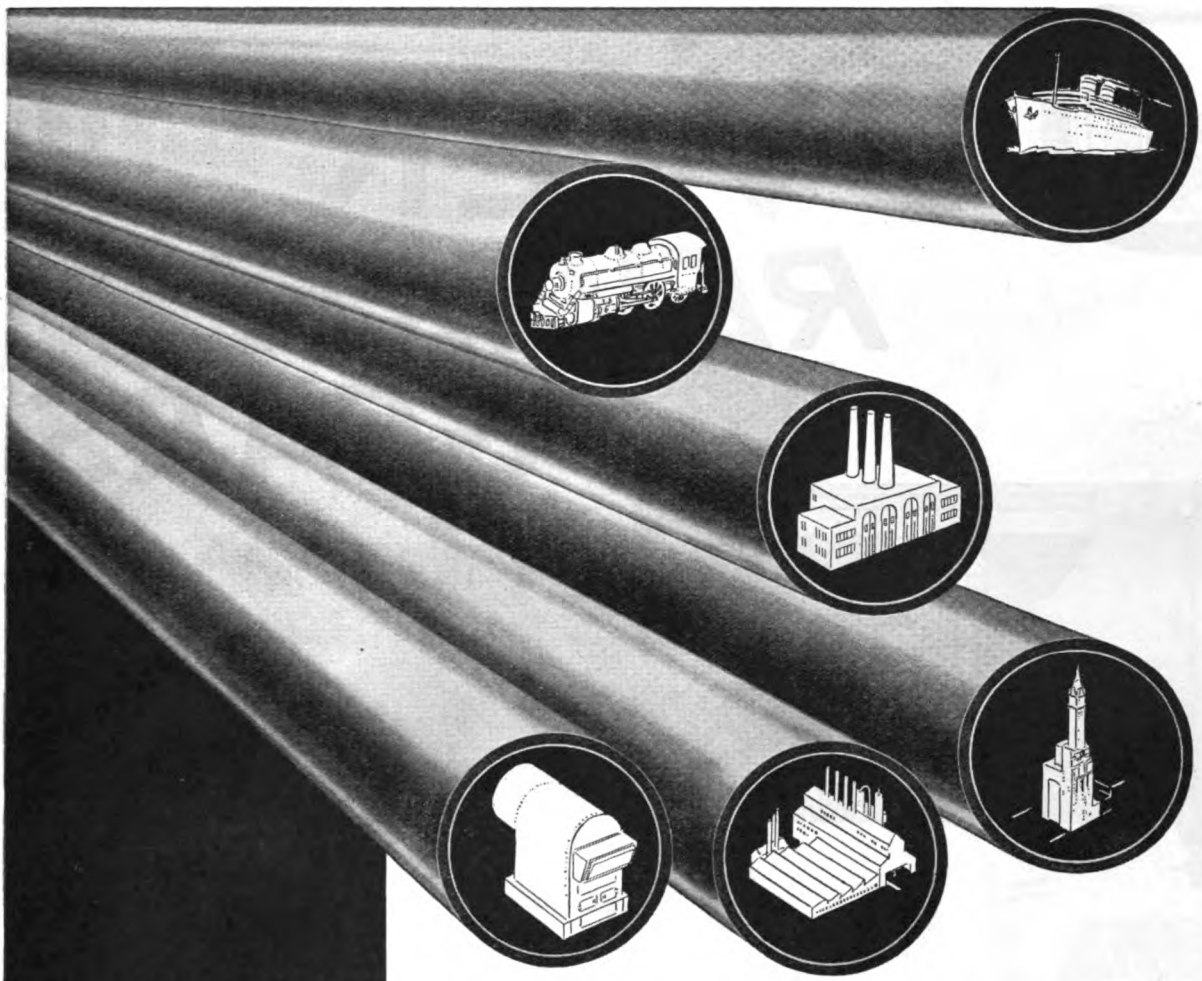
TIMKEN Bearings in your car journals mean an 88% decrease in starting resistance.

In other words, with cars mounted on Timken Bearings you can (1) start and haul average-length trains at considerably lower cost or (2) start and haul longer, heavier trains at no increase in cost.

Furthermore, the reduction in power consumption through the use of Timken Bearing journals compensates for the additional load on the locomotive resulting from increased train speeds. Your plain bearing cars and locomotives can be changed over to Timken Bearings quickly at moderate cost.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**



THERE MUST BE A reason

Two years ago, the Electrunite Boiler Tube was just an idea—but a good idea, judging by the progress it made during depression years when even old established products could boast only of new lows on the sales charts. There must be a reason.

For many years, Steel & Tubes, Inc., had been producing millions of feet of electric weld tubing for mechanical uses; millions of feet of electric weld conduit for use in electrical wiring; and within the last few years the use of electric weld tubing for pressure work in heat transfer equipment reached such proportions that the Electrunite Boiler Tube was a very natural development.

Today, the Electrunite Boiler Tube may be found in every field of industry where power and heating are requisites. Thousands of tons have been installed in all types of boilers—marine, locomotive and stationary. It is used in high pressure fire tube and water tube boilers of both bent and straight tube type. Leading railroads, central power stations, boiler manufacturers, ship owners, general industrials and federal departments have adopted Electrunite and continue to use it.

The reasons for the remarkable progress made by the Electrunite Boiler Tube are not hard to find. Because it is made from flat-rolled steel, it possesses a uniformity in diameter, wall thickness and concentricity not attained in tubes made by other processes. Due to the accurately-controlled electrical resistance method employed in welding, the weld is as strong as the wall. The tube is full-normalize-annealed—soft, ductile and of uniform grain structure—making possible tighter joints with worth while savings in time and labor. And every tube is tested at pressures far in excess of code requirements. Electrunite Boiler Tubes are carried in stock in principal cities.

ELECTRUNITE

Reg. U. S. Pat. Off.

STEEL & TUBES ELECTRIC WELD

BOILER TUBES

STEEL AND TUBES, INC.

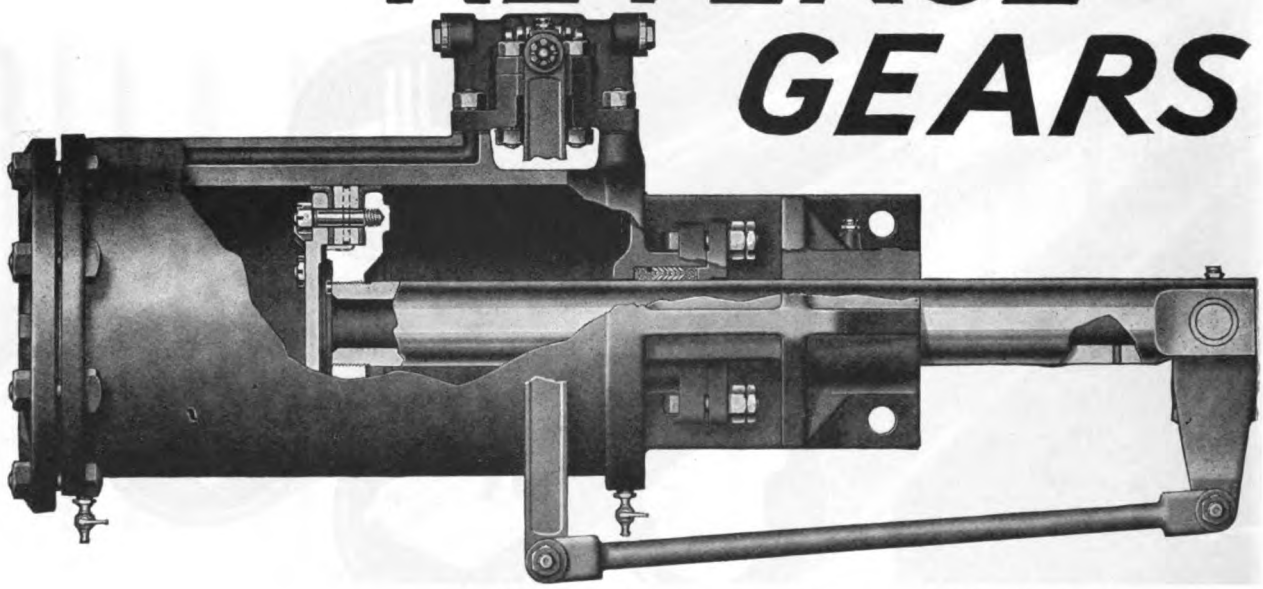
WORLD'S LARGEST PRODUCER OF ELECTRICALLY WELDED TUBING

CLEVELAND • • • OHIO

A UNIT OF REPUBLIC STEEL CORPORATION



POWER REVERSE GEARS



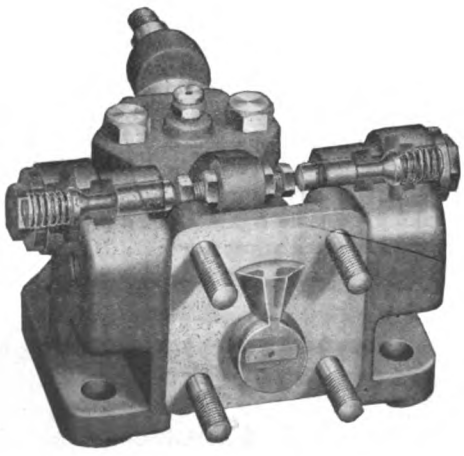
That Insure Low Maintenance—

cost and long trouble-free service. These desirable advantages are offered with BARCO Power Reverse Gears through exclusive features.

OUTBOARD PISTON ROD BEARING AND GUIDE. This guide is cast integral with the cylinder and bolted direct to the reverse gear bracket. It eliminates any weaving action of the piston rod on the piston rod packing and piston packing cups thus greatly increasing their service life. The bearing is always in perfect alignment as it does not have to be disturbed during repacking.

DUAL CONTROL VALVE. The combination of small rotary admission valve keyed to the shaft with poppet valves for exhaust provides exceptionally close adjustment and maintains the point of cut-off selected. Centering of valve after each operation is assured. The entire valve is easily removed from reverse gear for repairs or exchange.

All other parts are built and designed to the latest and best power reverse gear practice, including the hollow trunk piston rod.



Interior BARCO Dual Control Valve

Barco Manufacturing Co.

1801 Winnemac Avenue, Chicago, Illinois

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BARCO



North or South, East or West,—wherever you may be during the holiday season, we again send you greetings from the home of the Wyandotte Indian. May the New Year bring you a fuller share of contentment and prosperity and as much genuine pleasure in all your business relationships as we have felt in our relationship with you!

The J. B. Ford Company

Wyandotte, Michigan

Wyandotte PRODUCTS

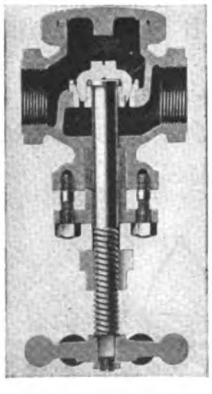
FIG. 999 is a RECORD-BREAKER!



Even after 14 months service on blower line of a crack train Jenkins new Fig. 999 was leak-tight

ANOTHER Fig. 999 Blower Valve, on another famous train carrying 250 pounds pressure, was found to be in perfect condition after 17 months of duty. Certainly such service is record-breaking... yet it may be expected of this valve.

Fig. 999 is designed to meet the need for a REAL blower valve...one which stays tight without attention much longer than the ordinary heavy bevel seat type of valve. Also, it is made to operate with greater ease and positiveness. See the expense-saving details below. Then write for blueprint and Bulletin No. 82.



Note unique reverse acting plug seating mechanism, the inlet pressure being applied on disc. Body and cap are of special hard bronze; seat ring and plug of nickel alloy; other parts subject to corrosion are of stainless steel. Withstands 300 lbs. S.W.P., and total temperatures to 700°F. Made in 1¼" size only; weight, 11 lbs. 3 ozs. Available for Hancock No. 2 Universal Joint.

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Jenkins Valves

BRONZE — IRON — STEEL SINCE 1864

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Consistently Positive Operation—Long or Short Trains

Signals Always Distinct—No Interference Nor Overlapping

Wear Does Not Affect Consistent Operation

Maintenance Costs are Very Low



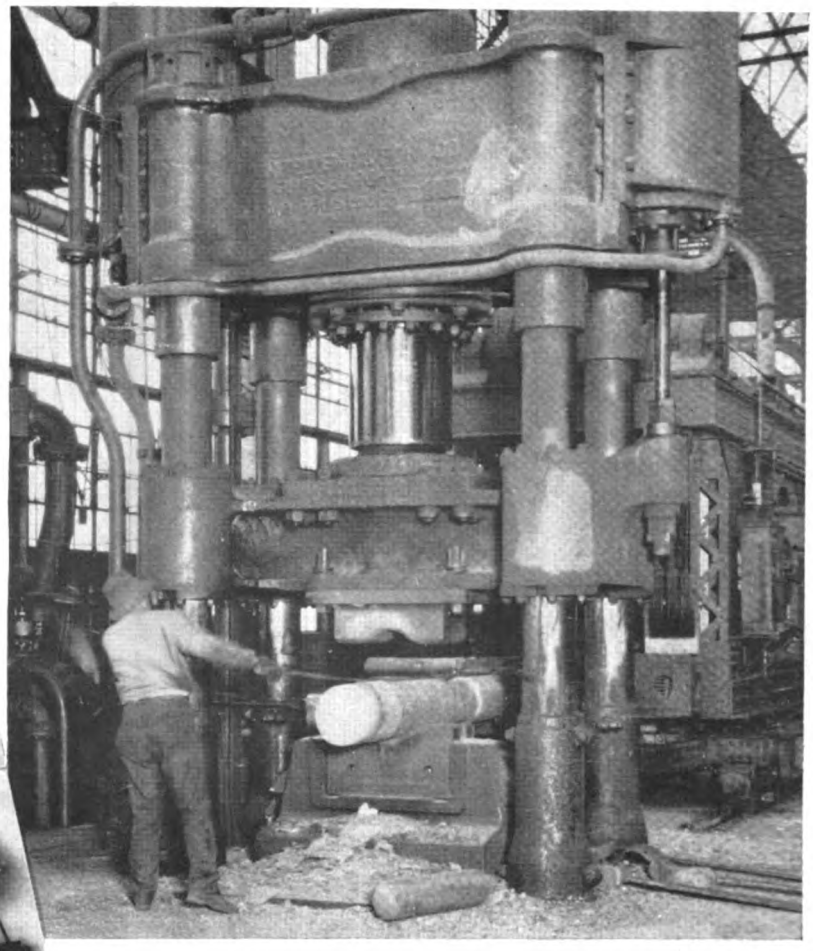
A SUPERIOR SIGNAL VALVE

WESTINGHOUSE AIR BRAKE COMPANY

General Office and Works, WILMERDING, PA.

ALCO

QUALITY ALL WAYS
QUALITY ALWAYS
FORGINGS





They're TOUGH *and* Shock Resistant

With a hundred years of locomotive building experience and a well-rounded knowledge of locomotive requirements—Alco is able to build forgings that are successful in resisting the severe shocks and stresses encountered in service.

Thousands of Alco-Built locomotives have demonstrated that the mechanical excellence of Alco Forgings protect engine service, and their toughness, strength, and uniformity prevent many important items of maintenance.

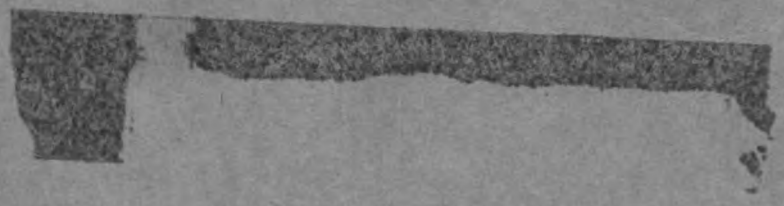
When you rebuild locomotives—build with Alco Forgings—the high quality Forgings which are

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